United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with South Dakota Agricultural Experiment Station at South Dakota State University

Soil Survey of Haakon County, South Dakota

How to Use This Soil Survey

General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

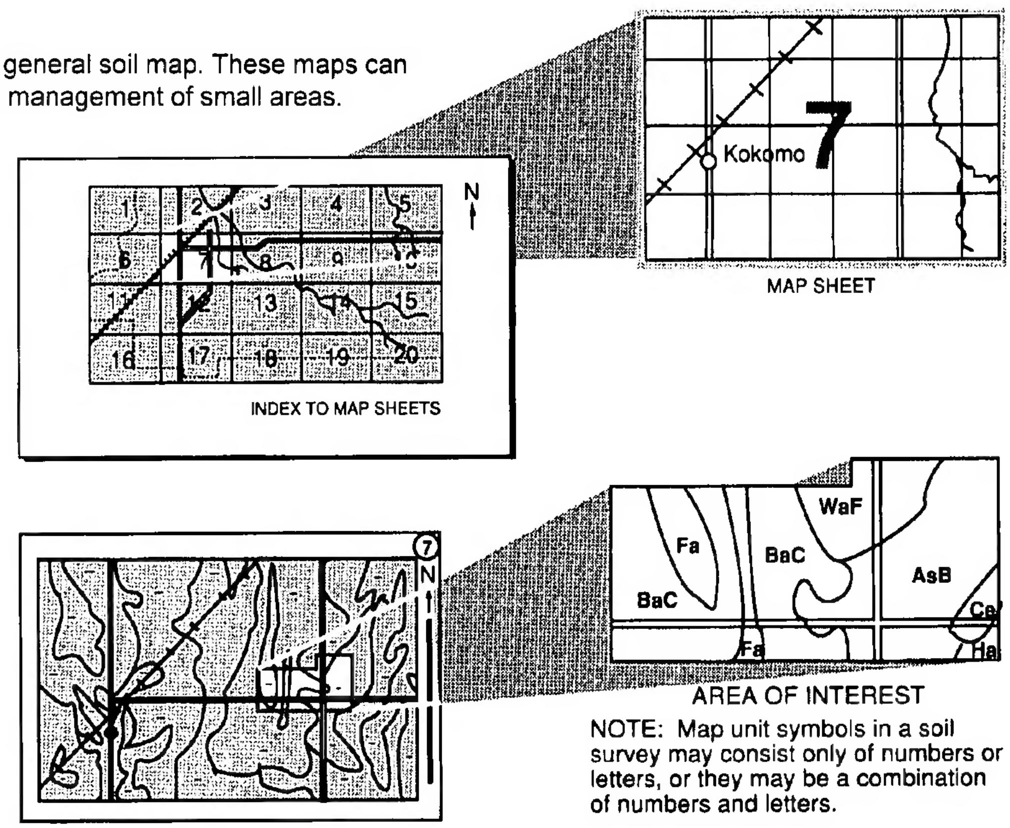
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet and turn to that sheet.

Locate your area of interest on the map sheet. Note the map units symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.



NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

MAP SHEET

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1991. Soil names and descriptions were approved in 1991. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1991. This survey was made cooperatively by the Natural Resources Conservation Service and the South Dakota Agricultural Experiment Station at the South Dakota State University. It is part of the technical assistance furnished to the Haakon County Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Natural Resources Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Winter roundup on a ranch south of Midland in an area of Lakoma silty clay, 3 to 6 percent slopes.

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Issued 1998

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Foreword

This soil survey contains information that can be used in land-planning programs in Haakon County, South Dakota. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for optimum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the South Dakota Cooperative Extension Service.

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Soil Survey of Haakon County, South Dakota

By Allen A. Faulkner, Natural Resources Conservation Service

Soils surveyed by Sharon K. Boschee, Edgar H. Ensz, Allen A. Faulkner, Kenneth J. Heil, Roland K. Krauss, Robert D. Nielsen, Kendall K. Olson, and Richard L. Schlepp, Natural Resources Conservation Service, and Lawrence P. Haugen and Arvid C. Meland, professional soil classifiers

United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with
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Haakon County is in the central part of South Dakota (fig. 1). It has a total area of 1,168,224 acres.

General Nature of the County

This section gives general information about the county. It describes climate; physiography, relief, and drainage; settlement; ranching and farming; and natural resources.

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Philip in the period 1951 to 1987. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 22 degrees F and the average daily minimum temperature is 9 degrees. The lowest temperature on record, which occurred at Philip on January 21, 1966, is -33 degrees. In summer, the average temperature is 72 degrees and the average daily maximum temperature is 87 degrees. The highest recorded temperature, which occurred at Philip on August 26, 1970, is 113 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

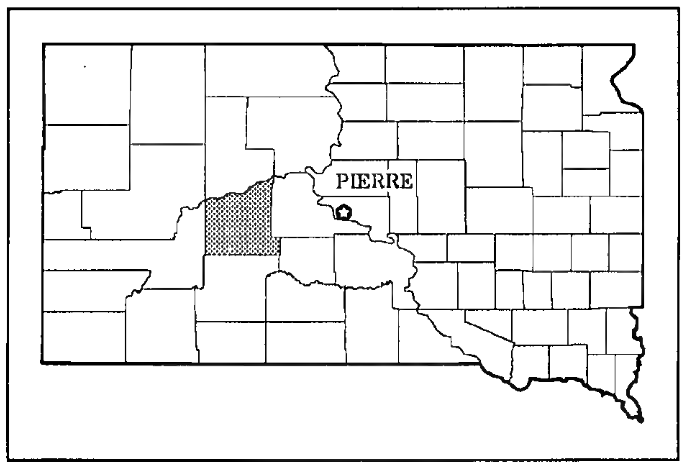

Figure 1.—Location of Haakon County in South Dakota.

The total average annual precipitation is nearly 16 inches. Of this, more than 12.5 inches, or about 80 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 11 inches. The heaviest 1-day rainfall during the period of record was 3.13 inches at Philip on August 26, 1970. Thunderstorms occur on about 42 days each year.

The average seasonal snowfall is about 27 inches. The greatest snow depth at any one time during the period of record was 26 inches. On the average, 26 days of the

year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 70 percent. The sun shines 75 percent of the time possible in summer and 55 percent in winter. The prevailing wind is from the north-northwest. Average wind speed is highest, 13 miles per hour, in spring.

Several times each winter, storms with snow and high wind bring blizzard conditions to the survey area. Hail falls in scattered small areas during summer thunderstorms.

Physiography, Relief, and Drainage

Haakon County is part of the Pierre Hills region in the Missouri Plateau section of the Great Plains physiographic division *(8)*. Slopes generally are nearly level to strongly sloping, but they are moderately steep to very steep in areas along the Bad River, the Cheyenne River, and the major drainageways. A few prominent buttes rise above the surrounding landscape in the western part of the county.

The northern half of the county is drained by the Cheyenne River and its tributaries. The Cheyenne River forms the northern border of the county and flows throughout the year. The southern half of the county is drained by the Bad River and its tributaries. The Bad River flows during the spring snowmelt and after periods of significant rainfall.

Land elevations range from about 1,620 feet above sea level at Lake Oahe to 2,767 feet in the southwestern part of the county. The lowest elevation of the Bad River is 1,790 feet.

Settlement

Haakon County was established in 1914 *(4)* and organized in 1915 *(3)*. It had formerly been part of Stanley County. It was named in honor of Haakon VII, King of Norway.

The Sioux were early inhabitants of the survey area. French fur traders were in the area around the turn of the nineteenth century. The earliest settlement was Leslie, along the Cheyenne River *(3)*. Settlement increased dramatically after 1890 because of provisions of the Homestead Law and was accelerated in 1906 and 1907, when the Chicago and Northwestern Railroad was completed through the county. The towns of Midland, Nowlin, Philip, and Powell grew rapidly with the help of the railroad. Settlement then proceeded northerly throughout the county. By 1911, the most productive land in the county was settled.

The population of Haakon County was 4,360 in 1939 *(4)* and 2,624 in 1990 *(12)*. Philip, the county seat, was named after James "Scotty" Philip, a former local ranch operator *(3)*. It had a population of 778 in 1939 *(4)*, 1,000 in 1970 *(3)*, and 1,077 in 1990 *(12)*. Other communities in the county are Midland and Milesville.

South Dakota Highways 34 and 73 and U.S. Highway 14 and are the main transportation routes in the county. Most rural areas are served by graveled roads. The Chicago and Northwestern Railroad operated until it was purchased by the Dakota, Minnesota, and Eastern Railroad in September 1986. Philip has a small airport. A few small private landing strips are in scattered areas throughout the county.

Ranching and Farming

Ranching is the principal enterprise in Haakon County. Beef cattle and sheep are the main types of livestock. About 71 percent of the farm income in the county is derived from the sale of livestock and livestock products *(13)*. Many of the crops grown in the county are used for livestock feed. Most of the small grain is sold as a cash crop.

In 1992, the county had 321 ranches and farms, which averaged about 3,752 acres in size *(13)*. The trend is toward fewer and larger ranches and farms.

About 65 percent of the acreage in the county is range, and about 31 percent is used for cultivated crops or for tame pasture and hay *(5)*. Winter wheat, grain sorghum, forage sorghum, spring wheat, oats, and alfalfa are the main crops. In 1994, about 116,000 acres was planted to winter wheat and about 8,000 acres was planted to grain sorghum *(7)*. Barley, corn, and sunflowers also were grown. Alfalfa, crested wheatgrass, and intermediate wheatgrass are the main plants grown for tame pasture and hay.

The Haakon County Soil Conservation District was organized in 1943. It has been instrumental in planting grasses and trees to help control erosion. The trees also provide protection for farmsteads and wildlife.

Natural Resources

Soil is the most important natural resource in Haakon County. It provides a growing medium for crops and the grasses grazed by livestock. Other natural resources are water, sand and gravel, and wildlife.

The main sources of water for livestock are stock-water impoundments and wells. The quantity of water generally is greater in the deep wells, but the quality is poor because of a high content of soluble salts. The Cheyenne River and a few perennial streams and springs are sources of water for livestock and wildlife. The Bad River flows only intermittently and provides water only during periods of snowmelt and heavy rainfall. Dugouts in areas

of Hoven and Kolls soils provide additional water for livestock and wildlife. Waggoner Lake provides opportunities for boating and fishing.

Deposits of sand and gravel are in scattered areas throughout the county. They range from a few inches to many feet thick. In areas of Schamber soils, the sand and gravel can be used as concrete aggregate and construction material, as subgrade material for roads, and as bituminous aggregate.

Antelope, white-tailed deer, mule deer, pheasant, sharp-tailed grouse, prairie chicken, and gray partridge are the chief wildlife resources in Haakon County. Coyote, fox, and raccoon are the main predators. Bass, bluegill, crappies, and perch inhabit many stock-water impoundments. Walleye, northern pike, and catfish inhabit Lake Oahe. Catfish inhabit the Bad and Cheyenne Rivers.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs

show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils. The areas of included soils can be as much as 5 acres in size.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The soils in the associations are in a variety of landform positions (fig. 2). These different landform positions affect such characteristics as the amount of topsoil, the drainage class, the runoff rate, and the content of organic matter.

The 15 associations in this county have been grouped for broad interpretive purposes. The associations and the groups are described on the pages that follow. The names of the associations do not coincide exactly with those on the general soil maps in the published surveys of Jackson, Jones, Pennington, and Stanley Counties. Differences are the result of variations in the design and composition of the map units, variability within the physiographic area, or changes and refinements in series concepts.

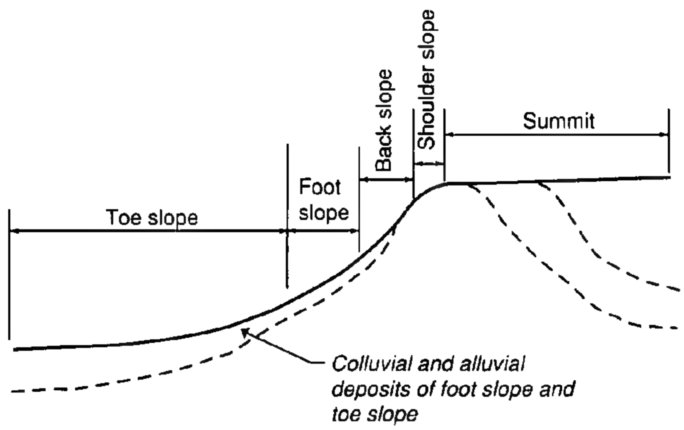

Figure 2.—Landform positions.

Soil Descriptions

Nearly Level and Gently Undulating, Sandy, Loamy, and Clayey Soils on Flood Plains

These soils dominantly are nearly level but are gently undulating in some areas. They make up about 5 percent of the county. About 95 percent of the acreage is range. Maintaining the most productive grasses is the main concern in managing range. Some areas are used for crops, mainly alfalfa, forage sorghum, and oats. Conserving moisture and controlling wind erosion are the main management concerns in cultivated areas.

1. Bankard-Craft-Wendte Association

Very deep, somewhat excessively drained, well drained, and moderately well drained, nearly level and gently undulating, sandy, clayey, and loamy soils on flood plains

This association is on flood plains. The major flood plains are those along the Cheyenne River. The soils formed in alluvium. Slopes are slightly convex or smooth in areas of the Bankard soils and smooth in the areas of the Wendte and Craft soils. The soils are subject to flooding in the spring and after periods of heavy rainfall. The flooding usually is of short duration.

This association makes up about 2 percent of the county. It is about 35 percent Bankard soils, 28 percent Craft soils, 17 percent Wendte soils, and 20 percent minor soils (fig. 3).

The somewhat excessively drained Bankard soils are on high flood plains. Slopes range from 0 to 6 percent. Typically, the surface layer is grayish brown, calcareous loamy sand. The underlying material is pale brown, calcareous sand.

The well drained Craft soils are on high flood plains. Slopes range from 0 to 2 percent. Typically, the surface layer is grayish brown, calcareous very fine sandy loam. The underlying material is light brownish gray, calcareous very fine sandy loam and silt loam.

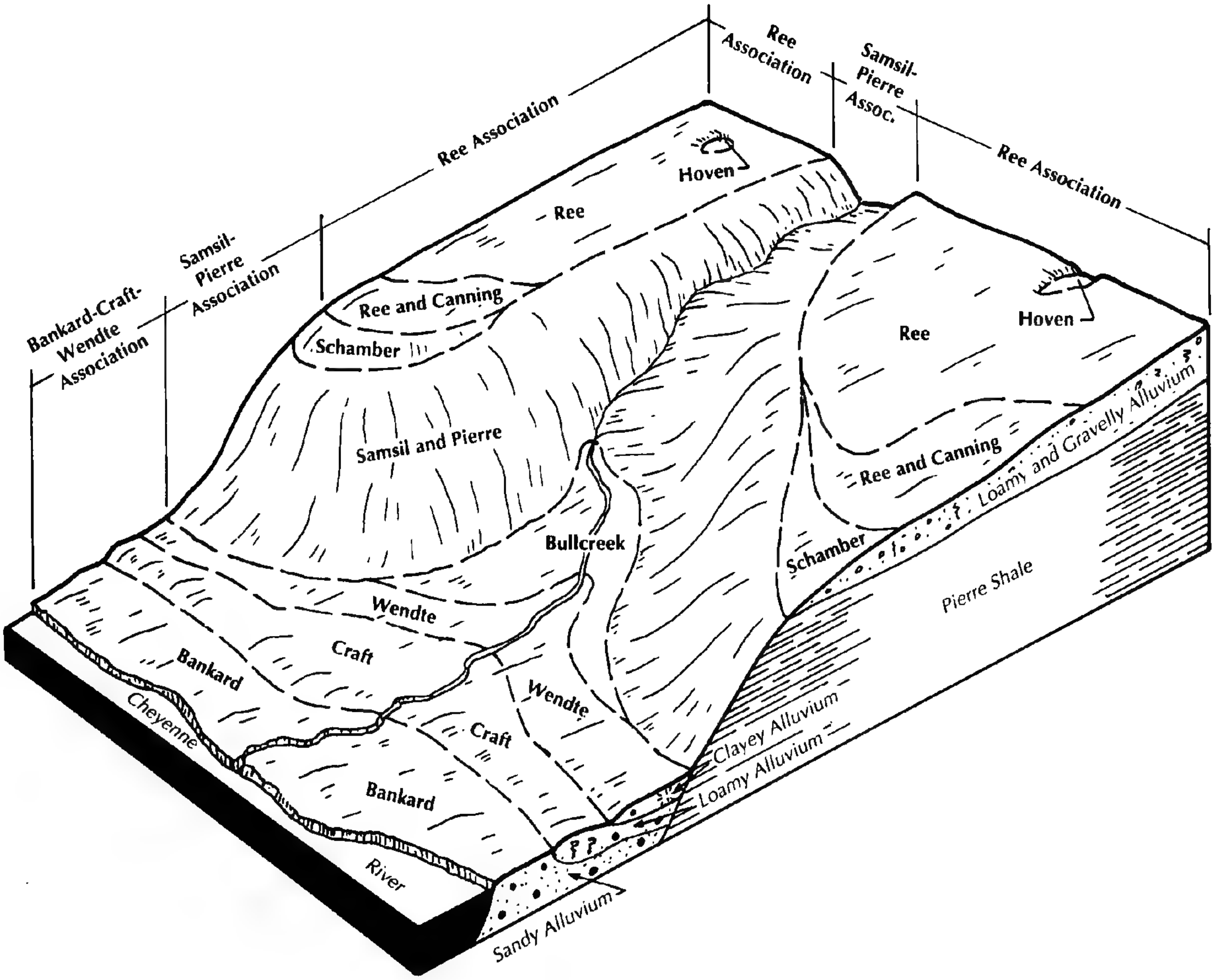

Figure 3.—Typical pattern of soils and parent material in the Bankard-Craft-Wendte, Ree, and Samsil-Pierre associations.

The moderately well drained Wendte soils are on high flood plains. Slopes range from 0 to 2 percent. Typically, the surface layer is grayish brown, calcareous silty clay. The underlying material is grayish brown and light brownish gray, calcareous, stratified clay and silty clay loam.

Minor in this association are the Haverson and Hilmoe soils and areas of Riverwash. The loamy Haverson soils are intermingled with areas of the Craft soils. The clayey Hilmoe soils are in positions on the landscape similar to those of the Wendte soils. Riverwash is adjacent to the Cheyenne River. It has gravel at the surface. It generally does not support vegetation.

About 95 percent of this association is range. Maintaining the most productive grasses is the main concern in managing range. The major soils are suited to range and rangeland wildlife habitat. Deciduous trees and shrubs along the Cheyenne River provide protection for livestock and wildlife. Most of the cropland is in areas of the Craft and Wendte soils. Alfalfa and forage sorghum are the main crops. Conserving moisture and controlling wind erosion are the main concerns in managing cultivated areas. The Craft and Wendte soils are suited to cultivated crops and to tame pasture and hay. The Bankard soils generally are unsuited to cultivated crops because of droughtiness, which is caused by a low available water capacity.

2. Nimbro Association

Very deep, well drained, nearly level, loamy soils on flood plains

This association is along the Bad River. The soils formed in alluvium. Slopes are smooth or slightly convex.

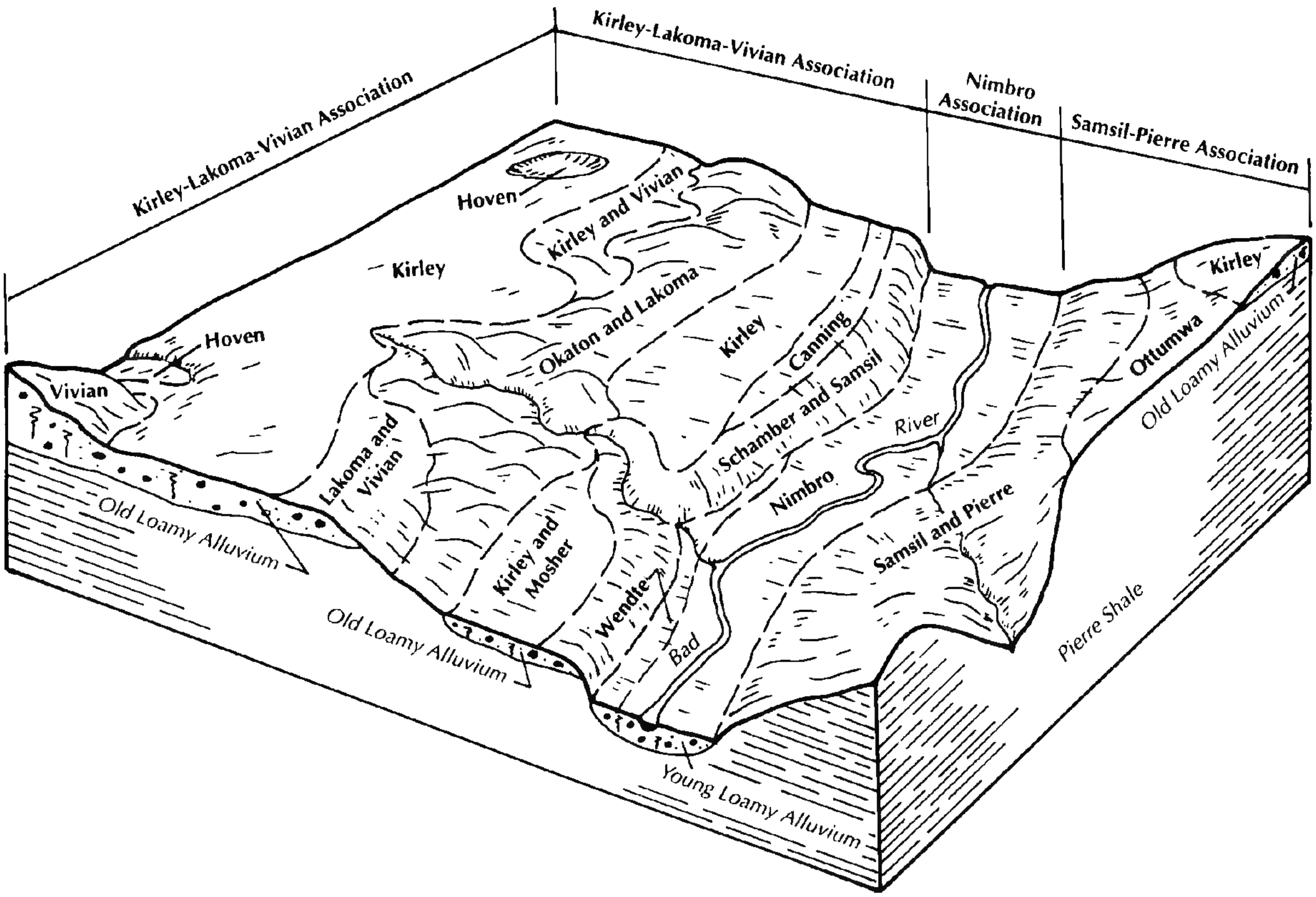

Figure 4.—Typical pattern of soils and parent material in the Nimbro, Samsil-Pierre, and Kirley-Lakoma-Vivian associations.

This association makes up about 3 percent of the county. It is about 80 percent Nimbro soils and 20 percent minor soils (fig. 4).

The Nimbro soils are on high flood plains. Slopes are less than 2 percent. Typically, the surface layer is grayish brown, calcareous silty clay loam. The underlying material is light brownish gray and grayish brown, calcareous silty clay loam. It has masses of gypsum and other salts in the lower part.

Minor in this association are the Albaton, Bullcreek, Craft, Hilmoe, and Wendte soils. The very poorly drained Albaton soils are on low flood plains. The dense Bullcreek soils are on smooth or convex fans or terraces above the Nimbro soils. The well drained Craft and moderately well drained Hilmoe and Wendte soils are in positions on the landscape similar to those of the Nimbro soils.

About 95 percent of this association is range. Maintaining the most productive grasses is the main concern in managing range. The Nimbro soils are suited to range and rangeland wildlife habitat. Deciduous trees and shrubs along the Bad River provide protection for livestock and wildlife. Most of the cropland in this association is in areas of the Nimbro and Wendte soils. Alfalfa, forage sorghum, and winter wheat are the main crops. Conserving moisture and controlling wind erosion are the main concerns in managing cultivated areas. The Nimbro soils are suited to cultivated crops and to tame pasture and hay.

Nearly Level to Moderately Sloping, Loamy Soils on Terraces

These soils dominantly are nearly level and gently sloping but are moderately sloping in places. They make up about 6 percent of the county. About 85 percent of the acreage is cropland. Winter wheat, corn, grain sorghum, oats, and alfalfa are the main crops. Conserving moisture and controlling water erosion are the main management concerns in cultivated areas.

3. Ree Association

Very deep, well drained, nearly level to moderately sloping, loamy soils on terraces

This association is on high alluvial terraces characterized by long, smooth slopes and numerous

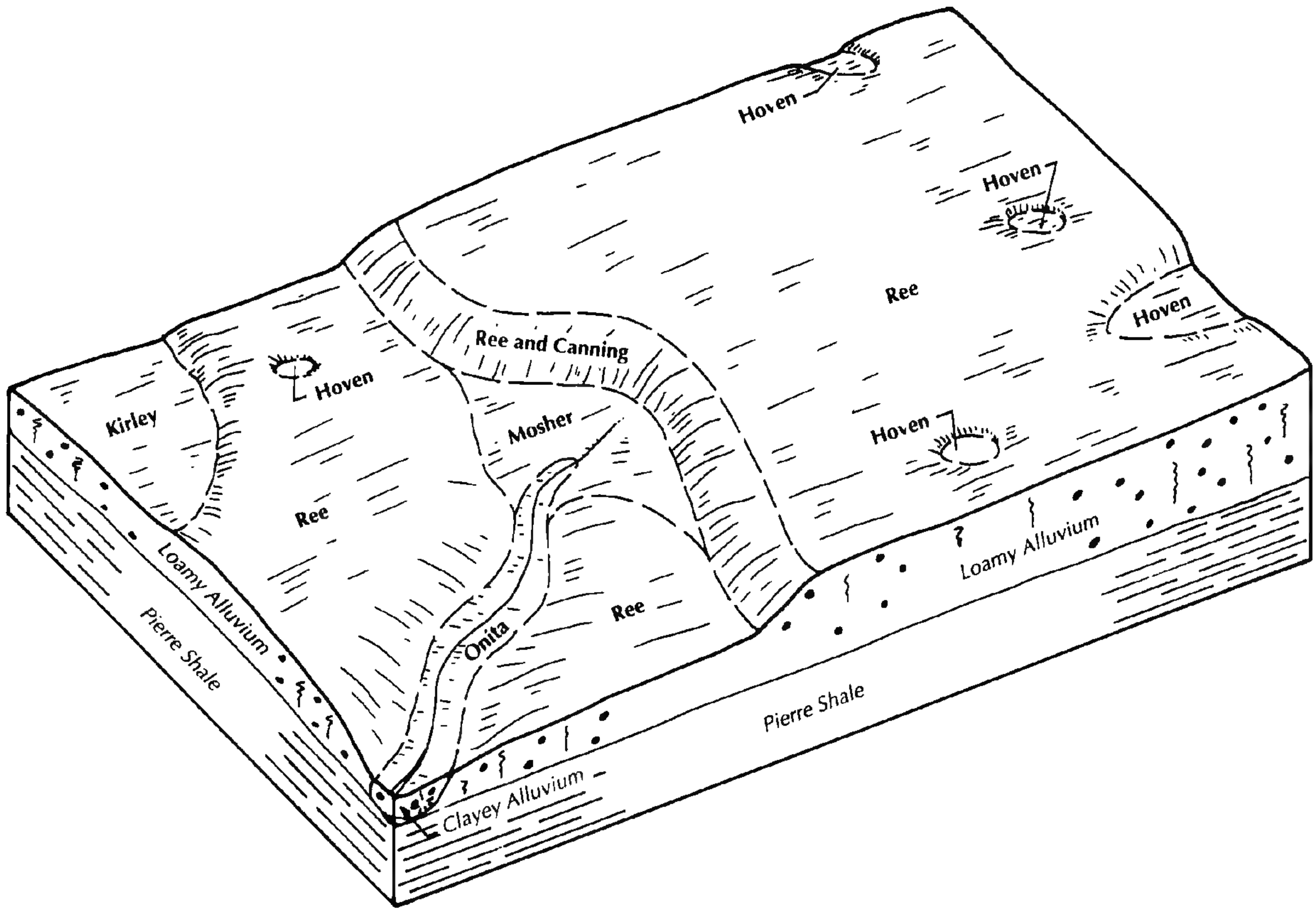

Figure 5.—Typical pattern of soils and parent material in the Ree association.

swales and small basins. The soils formed in alluvium. Slopes dominantly are nearly level but are gently undulating or moderately sloping in some areas. The drainage pattern is poorly defined in most areas. Drainageways terminate in basins.

This association makes up about 6 percent of the county. It is about 85 percent Ree soils and 15 percent minor soils (fig. 5).

The Ree soils are on summits, back slopes, and foot slopes. Slopes range from 0 to 9 percent. Typically, the surface layer is dark grayish brown loam. The subsoil is grayish brown and light brownish gray clay loam, loam, and sandy loam. It is calcareous in the lower part. The underlying material is light brownish gray, calcareous loamy sand.

Minor in this association are the Canning, Hoven, Kirley, Mosher, and Onita soils. The well drained Canning soils have gravelly material at a depth of 20 to 40 inches. The poorly drained Hoven soils are in basins. The well drained Kirley soils contain more clay than the Ree soils and are in slightly lower positions on the landscape. The moderately well drained, sodium-affected Mosher soils are on foot slopes. The moderately well drained Onita soils also are on foot slopes.

About 85 percent of this association is cropland. Winter wheat, corn, grain sorghum, oats, and alfalfa are the main crops. Conserving moisture and controlling water erosion are the main management concerns. The Ree soils are suited to cultivated crops, to tame pasture and hay, and to range.

Nearly Level to Strongly Sloping, Clayey Soils on Undissected and Dissected Plains

These soils dominantly are nearly level to moderately sloping but are strongly sloping along some drainageways. They make up about 30 percent of the county. About 55 percent of the acreage is cropland. The rest is dominantly range. Winter wheat, grain sorghum, oats, and alfalfa are the main crops. Controlling erosion, conserving moisture, and increasing a slow rate of water infiltration are the main management concerns.

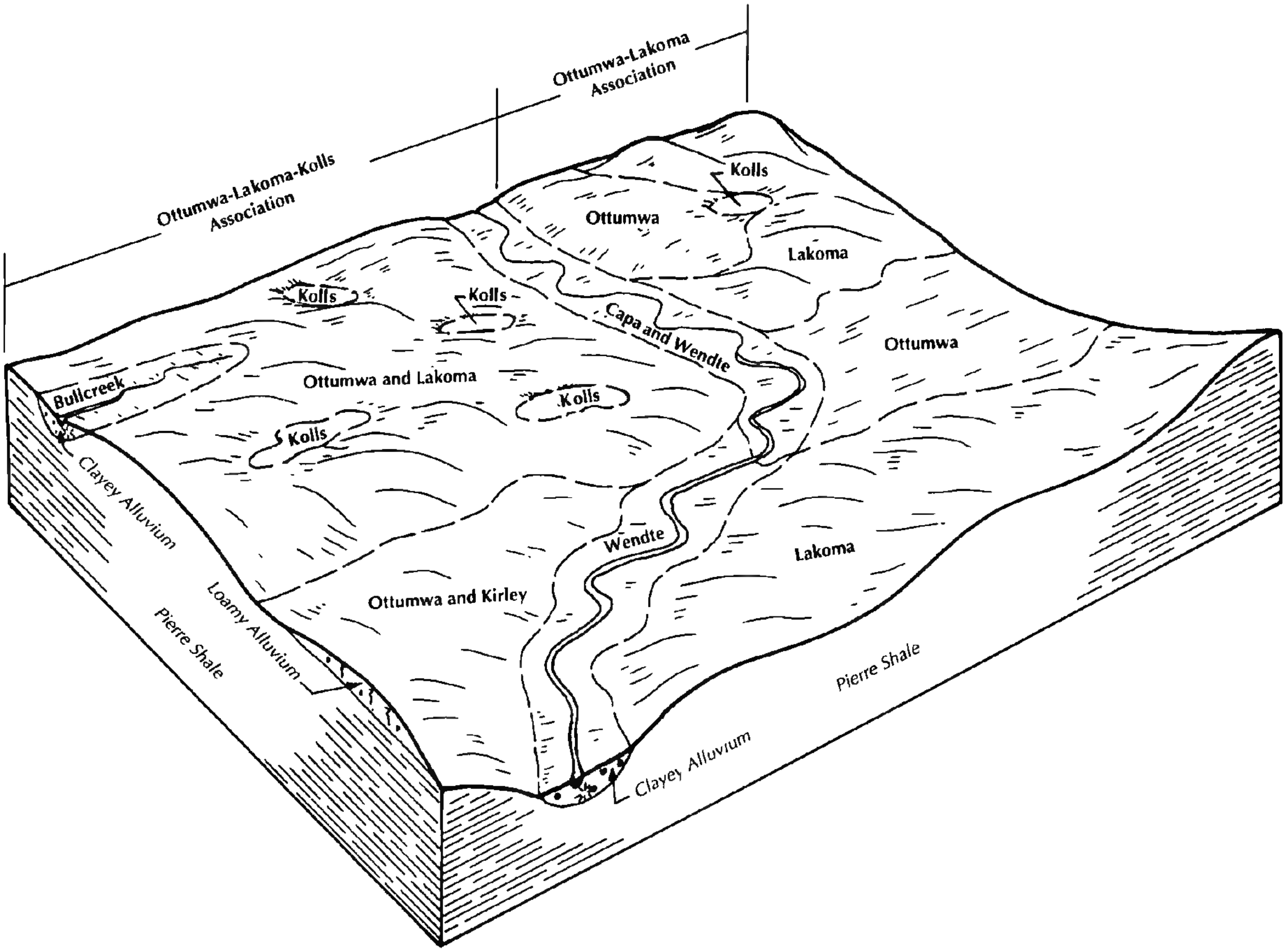

Figure 6.—Typical pattern of soils and parent material in the Ottumwa-Lakoma-Kolls and Ottumwa-Lakoma associations.

4. Ottumwa-Lakoma-Kolls Association

Very deep and moderately deep, well drained and poorly drained, nearly level to moderately sloping, clayey soils on undissected and dissected plains

This association is characterized by low ridges, basins, and entrenched drainageways. The Ottumwa and Lakoma soils formed in clayey shale residuum, and the Kolls soils formed in clayey alluvium. Slopes dominantly are nearly level and gently sloping but are moderately sloping in some areas. The drainage pattern is well defined in most areas but is poorly defined where drainageways terminate in small basins.

This association makes up about 8 percent of the county. It is about 65 percent Ottumwa soils, 20 percent Lakoma soils, 10 percent Kolls soils, and 5 percent minor soils (fig. 6).

The very deep, well drained Ottumwa soils are on the lower back slopes and on foot slopes. Slopes range from 0 to 9 percent. Typically, the surface layer is dark grayish brown silty clay. The subsoil is dark grayish brown, grayish brown, and light brownish gray, calcareous clay and silty clay. It has masses of gypsum and other salts in the lower part. The underlying material is light brownish gray, calcareous silty clay that has masses of gypsum and other salts.

The moderately deep, well drained Lakoma soils are on back slopes. Slopes range from 2 to 9 percent. Typically, the surface layer is dark grayish brown, calcareous silty clay. The subsoil and the underlying material are grayish brown and light brownish gray, calcareous silty clay. Light gray, calcareous shale bedrock is at a depth of about 28 inches.

The very deep, poorly drained Kolls soils are in basins. Slopes are 0 to 1 percent. Typically the surface layer is gray clay. The subsoil is gray, calcareous clay. The underlying material is grayish brown and gray, calcareous clay that has masses of gypsum and other salts.

Minor in this association are the Bullcreek, Capa, Kirley, Promise, and Wendte soils. The dense Bullcreek

soils are on the foot slopes of terraces and fans. The moderately well drained Capa soils have a sodium-affected subsoil and are on foot slopes. The loamy Kirley soils are on the summits and back slopes of terraces. The deep and very deep Promise soils are on foot slopes. The stratified Wendte soils are on high flood plains.

About 80 percent of this association is cropland. Some areas are used as range. The Ottumwa and Lakoma soils are suited to cultivated crops, to tame pasture and hay, and to range and rangeland wildlife habitat. Winter wheat, grain sorghum, oats, and alfalfa are the main crops. Controlling erosion, conserving moisture, and increasing a slow rate of water infiltration are the main management concerns in cultivated areas. Maintaining the most productive grasses is the main concern in managing range. The Kolls soils are generally unsuited to cultivated crops and to tame pasture and hay because of ponding.

5. Ottumwa-Lakoma Association

Very deep and moderately deep, well drained, nearly level to strongly sloping, clayey soils on undissected and dissected plains

This association is characterized by many knolls, hills, and ridges separated by strongly entrenched drainageways. The soils formed in clayey shale residuum. Slopes generally are nearly level to moderately sloping but are steeper along drainageways and on some ridges and hills. The drainage pattern is well defined.

This association makes up about 17 percent of the county. It is about 45 percent Ottumwa soils, 35 percent Lakoma soils, and 20 percent minor soils (fig. 6).

The very deep Ottumwa soils are on back slopes and foot slopes. Slopes range from 0 to 9 percent. Typically, the surface layer is dark grayish brown silty clay. The subsoil is dark grayish brown, grayish brown, and light brownish gray, calcareous clay and silty clay having masses of gypsum and other salts. The underlying material is light brownish gray, calcareous silty clay that has masses of gypsum and other salts.

The moderately deep Lakoma soils are on summits and back slopes. Slopes range from 3 to 15 percent. Typically, the surface layer is dark grayish brown, calcareous silty clay. The subsoil and the underlying material are grayish brown and light brownish gray, calcareous silty clay. Light gray, calcareous shale bedrock is at a depth of about 28 inches.

Minor in this association are the Bullcreek, Capa, Herdcamp, Kirley, Kolls, Opal, Promise, and Wendte soils. The dense Bullcreek soils are on the foot slopes of terraces and fans. The sodium-affected Capa soils are on foot slopes. The very poorly drained Herdcamp soils are on low flood plains. The loamy Kirley soils are in positions on the landscape similar to those of the Ottumwa soils. The very poorly drained Kolls soils are in basins. The moderately deep Opal soils are on back slopes. The deep and very deep Promise soils are on the lower back slopes and on foot slopes. The very deep, stratified Wendte soils are on high flood plains.

About 60 percent of this association is range. Some areas are used for crops, mainly winter wheat, grain sorghum, oats, and alfalfa. Maintaining the most productive grasses is the main concern in managing range. The major soils are suited to range and rangeland wildlife habitat, to cultivated crops, and to tame pasture and hay. Controlling erosion, conserving moisture, and increasing a slow rate of water infiltration are the main concerns in managing cultivated areas, tame pasture, and hayland.

6. Pierre-Kyle Association

Moderately deep and very deep, well drained, nearly level to strongly sloping, clayey soils on undissected and dissected plains

This association is characterized by low ridges and shallow drainageways. The soils formed in clayey shale residuum. Slopes generally are gently sloping but are steeper on some ridges and are nearly level in some areas. The drainage pattern is well defined.

This association makes up about 1 percent of the county. It is about 50 percent Pierre soils, 40 percent Kyle soils, and 10 percent minor soils.

The moderately deep Pierre soils are on shoulder slopes and back slopes. Slopes range from 6 to 15 percent. Typically, the surface layer is grayish brown, calcareous clay. Below this is a transitional layer of light brownish gray, calcareous clay. The subsoil is light brownish gray, calcareous clay that has masses of gypsum and other salts. Light brownish gray and light olive gray shale bedrock is at a depth of about 27 inches. The shale is calcareous in the upper part.

The very deep Kyle soils are on foot slopes. Slopes range from 0 to 6 percent. Typically, the surface layer is grayish brown clay. The subsoil is grayish brown, calcareous clay. It has masses of gypsum and other salts in the lower part. The underlying material is light olive brown, calcareous clay that has masses of gypsum and other salts.

Minor in this association are the Arvada and Samsil soils. The sodium-affected Arvada soils are on foot slopes. The shallow Samsil soils are on shoulder slopes and the upper back slopes.

Nearly all of this association is range. Maintaining the most productive grasses is the main concern in managing range. The less sloping areas of the Pierre and Kyle soils are suited to cultivated crops, to tame pasture and hay, and to range and rangeland wildlife habitat.

7. Promise-Opal-Ottumwa Association

Very deep, deep, and moderately deep, well drained, nearly level to moderately sloping, clayey soils on undissected and dissected plains

This association is characterized by low ridges and hills separated by many small drainageways. The soils formed in clayey shale residuum. Slopes generally are gently sloping or moderately sloping but are nearly level in some areas.

This association makes up about 4 percent of the county. It is about 33 percent Promise soils, 33 percent Opal soils, 22 percent Ottumwa soils, and 12 percent minor soils.

The deep and very deep Promise soils are on the lower back slopes and on foot slopes. Slopes range from 0 to 6 percent. Typically, the surface layer is dark grayish brown clay. The subsoil is grayish brown, calcareous clay. The underlying material also is grayish brown, calcareous clay. It has masses of gypsum and other salts in the upper part.

The moderately deep Opal soils are on back slopes. Slopes range from 3 to 9 percent. Typically, the surface layer is dark gray and dark grayish brown, calcareous clay. The subsoil is dark grayish brown and grayish brown, calcareous clay. The underlying material is light brownish gray, calcareous clay. Light brownish gray shale bedrock is at a depth of about 36 inches.

The very deep Ottumwa soils are on back slopes and foot slopes. Slopes range from 0 to 9 percent. Typically, the surface layer is dark grayish brown silty clay. The subsoil is dark grayish brown, grayish brown, and light brownish gray, calcareous clay and silty clay having masses of gypsum and other salts. The underlying material is light brownish gray, calcareous silty clay that has masses of gypsum and other salts.

Minor in this association are the Bullcreek, Capa, Herdcamp, Kolls, Lakoma, and Wendte soils. The dense Bullcreek soils are on the foot slopes of terraces and fans. The sodium-affected Capa soils are on foot slopes. The very poorly drained Herdcamp soils are on low flood plains. The poorly drained Kolls soils are in basins. The moderately deep Lakoma soils are on back slopes. The very deep, stratified Wendte soils are on high flood plains.

About 55 percent of this association is range. The rest generally is used for crops, mainly winter wheat, grain sorghum, oats, and alfalfa. Maintaining the most productive grasses is the main concern in managing range. The major soils are suited to range and rangeland wildlife habitat, to cultivated crops, and to tame pasture and hay. Controlling erosion, conserving moisture, and increasing a slow rate of water infiltration are the main concerns in managing cultivated areas, tame pasture, and hayland.

Nearly Level to Steep, Clayey and Loamy Soils on Undissected and Dissected Plains and on Terraces

These soils dominantly are gently sloping to steep but are nearly level in places. They make up about 16 percent of the county. About 65 percent of the acreage is range. Maintaining the most productive grasses is the main concern in managing range. Some areas are used for crops, mainly winter wheat, grain sorghum, oats, and alfalfa. Controlling erosion, conserving moisture, and increasing a slow rate of water infiltration are the main concerns in managing cultivated areas.

8. Ottumwa-Kirley Association

Very deep, well drained, nearly level to moderately sloping, clayey and loamy soils on plains and terraces

This association is characterized by ridges and valleys. The Ottumwa soils formed in clayey shale residuum, and the Kirley soils formed in clayey alluvium. Slopes generally are gently sloping or moderately sloping but are nearly level in some areas and are strongly sloping along drainageways. The drainage pattern is well defined.

This association makes up about 5 percent of the county. It is about 45 percent Ottumwa soils, 27 percent Kirley soils, and 28 percent minor soils (fig. 7).

The Ottumwa soils are on back slopes and foot slopes. Slopes range from 0 to 9 percent. Typically, the surface layer is dark grayish brown silty clay. The subsoil is dark grayish brown, grayish brown, and light brownish gray, calcareous clay and silty clay having masses of gypsum and other salts. The underlying material is light brownish gray, calcareous silty clay that has masses of gypsum and other salts.

The Kirley soils are on summits, shoulder slopes, and back slopes. Slopes range from 2 to 9 percent. Typically, the surface layer is dark grayish brown clay loam. The subsoil is dark grayish brown clay in the upper part and grayish brown and light brownish gray, calcareous clay and clay loam in the lower part. The underlying material is light brownish gray, calcareous clay loam.

Minor in this association are the Bullcreek, Capa, Herdcamp, Hoven, Kolls, Lakoma, Mosher, and Wendte soils. The dense Bullcreek soils are on foot slopes. The sodium-affected Capa and Mosher soils are on foot slopes. The Capa soils have salts at a shallower depth than the Mosher soils. The very poorly drained Herdcamp soils are on low flood plains. The poorly drained Hoven and Kolls soils are in basins. The moderately deep Lakoma soils are on back slopes. The very deep, stratified Wendte soils are on high flood plains.

About 55 percent of this association is range. The rest generally is used for crops, mainly winter wheat, grain sorghum, oats, and alfalfa. Maintaining the most productive grasses is the main concern in managing

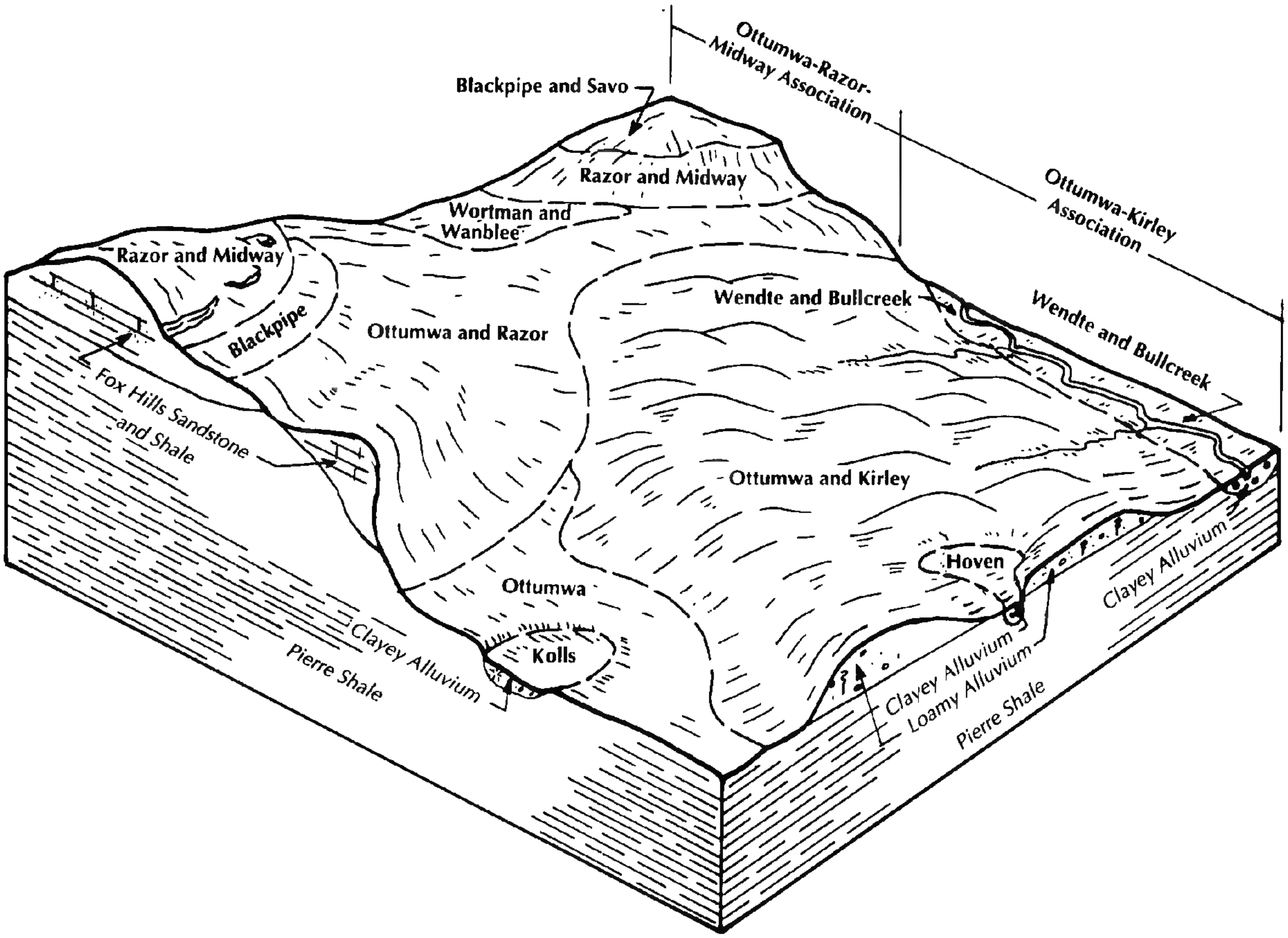

Figure 7.—Typical pattern of soils and parent material in the Ottumwa-Kirley and Ottumwa-Razor-Midway associations.

range. The major soils are suited to range and rangeland wildlife habitat, to cultivated crops, and to tame pasture and hay. Controlling erosion and conserving moisture are the main concerns in managing cultivated areas, tame pasture, and hayland.

9. Ottumwa-Razor-Midway Association

Very deep, moderately deep, and shallow, well drained, nearly level to steep, clayey and loamy soils on undissected and dissected plains

This association is characterized by gently sloping areas, sharp ridges, hills, and prominent buttes. The soils formed in clayey shale residuum. Slopes generally are gently sloping or moderately sloping but are nearly level in some areas and steep in others. The drainage pattern is well defined.

This association makes up about 11 percent of the county. It is about 33 percent Ottumwa soils, 25 percent Razor soils, 22 percent Midway soils, and 20 percent minor soils (fig. 7).

The very deep Ottumwa soils are on back slopes and foot slopes. Slopes range from 0 to 9 percent. Typically, the surface layer is dark grayish brown silty clay. The subsoil is dark grayish brown, grayish brown, and light brownish gray, calcareous clay and silty clay having masses of gypsum and other salts. The underlying material is light brownish gray, calcareous silty clay that has masses of gypsum and other salts.

The moderately deep Razor soils are on back slopes. Slopes range from 2 to 15 percent. Typically, the surface layer is grayish brown silty clay. The subsoil is grayish brown, light olive brown, and light brownish gray silty clay. It is calcareous in the lower part. Light yellowish brown, calcareous shale bedrock is at a depth of about 29 inches.

The shallow Midway soils are on shoulder slopes and the upper back slopes. Slopes range from 6 to 40 percent. Typically, the surface layer is light olive brown, calcareous silty clay loam. Below this is a transitional layer of light olive brown, calcareous clay. The underlying material is light yellowish brown, calcareous clay. Light yellowish

brown and light gray, calcareous shale bedrock is at a depth of about 13 inches.

Minor in this association are the Arvada, Blackpipe, Lohmiller, Savo, Wanblee, and Wortman soils. The very deep, sodium-affected Arvada soils, the moderately deep, sodium-affected Wanblee soils, and the moderately deep Wortman soils are on foot slopes. The moderately deep Blackpipe soils are on back slopes and foot slopes. The very deep, stratified Lohmiller soils are on high flood plains. The very deep Savo soils are on back slopes.

About 85 percent of this association is range. The major soils are suited to range. Maintaining the most productive grasses is the main concern in managing range. Some areas are used for crops, mainly alfalfa and winter wheat, which are grown mostly on the Ottumwa soils. The Ottumwa soils are suited to cultivated crops and to tame pasture and hay, but the Razor and Midway soils generally are unsuited because of the slope. Controlling erosion, conserving moisture, and increasing a slow rate of water infiltration are the main concerns in managing cultivated areas, tame pasture, and hayland.

Moderately Sloping to Steep, Clayey Soils on Dissected Plains

These soils dominantly are moderately sloping to steep but are very steep in places. They make up about 30 percent of the county. Most of the acreage is range. Maintaining the most productive grasses is the main concern in managing range. A few areas are used for alfalfa or winter wheat. Controlling erosion and conserving moisture are the main management concerns in cultivated areas.

10. Okaton-Lakoma Association

Shallow and moderately deep, well drained, strongly sloping to steep, clayey soils on dissected plains

This association is on breaks along the Bad River and its tributaries. The landscape is characterized by deeply entrenched drainageways. The soils formed in clayey shale residuum. Slopes generally are strongly sloping to steep. The drainage pattern is well defined.

This association makes up about 2 percent of the county. It is about 45 percent Okaton soils, 40 percent Lakoma soils, and 15 percent minor soils.

The shallow Okaton soils are on shoulder slopes and the upper back slopes. Slopes range from 15 to 40 percent. Typically, the soils are light brownish gray, calcareous silty clay to a depth of about 14 inches. Light brownish gray and pale yellow, calcareous shale bedrock is at a depth of about 14 inches.

The moderately deep Lakoma soils are on summits and back slopes. Slopes range from 9 to 30 percent. Typically, the surface layer is dark grayish brown, calcareous silty clay. The subsoil and the underlying material are grayish brown and light brownish gray, calcareous silty clay. Light gray, calcareous shale bedrock is at a depth of about 28 inches.

Minor in this association are the Bullcreek, Kirley, Sansarc, and Vivian soils. The dense Bullcreek soils are on the foot slopes of terraces and fans. The loamy Kirley soils are on summits and back slopes above the Okaton soils. The shallow Sansarc soils are on shoulder slopes and the upper back slopes. The gravelly Vivian soils are on the summits and shoulder slopes of terraces.

Nearly all of this association supports native grasses and is used as range. Controlling erosion and maintaining the most productive grasses are the main management concerns. The major soils are suited to range. They are generally unsuited to cultivated crops and to tame pasture and hay because of the slope.

11. Lakoma-Okaton Association

Moderately deep and shallow, well drained, moderately sloping to steep, clayey soils on dissected plains

This association is on breaks adjacent to the major drainageways. It is dissected by many well defined drainageways. The soils formed in clayey shale residuum. Slopes generally are moderately sloping to moderately steep but are steep in some areas.

This association makes up about 3 percent of the county. It is about 60 percent Lakoma soils, 25 percent Okaton soils, and 15 percent minor soils.

The moderately deep Lakoma soils are on summits and back slopes. Slopes range from 6 to 30 percent. Typically, the surface layer is dark grayish brown, calcareous silty clay. The subsoil and the underlying material are grayish brown and light brownish gray, calcareous silty clay. Light gray, calcareous shale bedrock is at a depth of about 28 inches.

The shallow Okaton soils are on shoulder slopes and the upper back slopes. Slopes range from 15 to 40 percent. Typically, the soils are light brownish gray, calcareous silty clay to a depth of about 14 inches. Light brownish gray and pale yellow, calcareous shale bedrock is at a depth of about 14 inches.

Minor in this association are the Canning, Kirley, Ottumwa, and Vivian soils. The loamy Canning and Kirley soils are on the summits and back slopes of terraces. Canning soils have sand and gravel at a depth of 20 to 40 inches. Kirley soils are not underlain by bedded shale. The very deep Ottumwa soils are on gently sloping plains. The gravelly Vivian soils are on the summits and shoulder slopes of terraces.

About 95 percent of this association supports native grasses and is used as range. Maintaining the most productive grasses is the main management concern. The major soils are suited to range. They are generally

unsuited to cultivated crops and to tame pasture and hay because of the slope.

12. Pierre-Samsil Association

Moderately deep and shallow, well drained, moderately sloping to very steep, clayey soils on dissected plains

This association is on shale plains dissected by many well defined drainageways. The soils formed in clayey shale residuum. Slopes generally are strongly sloping or moderately steep but are moderately sloping on foot slopes and are very steep along entrenched drainageways.

This association makes up about 12 percent of the county. It is about 65 percent Pierre soils, 20 percent Samsil soils, and 15 percent minor soils.

The moderately deep Pierre soils are on back slopes. Slopes range from 6 to 25 percent. Typically, the surface layer is grayish brown, calcareous clay. Below this is a transitional layer of light brownish gray, calcareous clay. The subsoil also is light brownish gray, calcareous clay. It has masses of gypsum in the lower part. Light brownish gray and light olive gray shale bedrock is at a depth of about 27 inches. The shale is calcareous in the upper part.

The shallow Samsil soils are on shoulder slopes and the upper back slopes. Slopes range from 15 to 60 percent. Typically, the surface layer is grayish brown, calcareous clay. Below this is a transitional layer of grayish brown, calcareous clay. The underlying material is light brownish gray, calcareous clay. Light brownish gray, calcareous shale bedrock is at a depth of about 14 inches.

Minor in this association are the Bullcreek, Kirley, Lakoma, Okaton, and Ottumwa soils. The dense Bullcreek soils are on the foot slopes of terraces and fans. The very deep, loamy Kirley soils are on the summits and back slopes of terraces. The moderately deep Lakoma and shallow Okaton soils contain more carbonates throughout than the major soils. The Lakoma soils are on summits and back slopes, and the Okaton soils are on shoulder slopes and the upper back slopes. The very deep Ottumwa soils are on foot slopes.

Nearly all areas of this association support native grasses and are used as range. Controlling erosion and maintaining the most productive grasses are the main management concerns. The major soils are suited to range. They generally are unsuited to cultivated crops and to tame pasture and hay because of the slope.

13. Samsil-Pierre Association

Shallow and moderately deep, well drained, strongly sloping to very steep, clayey soils on dissected plains

This association is on breaks along the Cheyenne and Bad Rivers and their tributaries. It is characterized by deeply entrenched drainageways. The soils formed in clayey shale residuum. Slopes generally are strongly sloping to steep but are very steep along some drainageways. The drainage pattern is well defined.

This association makes up about 13 percent of the county. It is about 65 percent Samsil soils, 20 percent Pierre soils, and 15 percent minor soils (fig. 3).

The shallow Samsil soils are on shoulder slopes and the upper back slopes. Slopes range from 15 to 60 percent. Typically, the surface layer is grayish brown, calcareous clay. Below this is a transitional layer of grayish brown, calcareous clay. The underlying material is light brownish gray, calcareous clay. Light brownish gray, calcareous shale bedrock is at a depth of about 14 inches.

The moderately deep Pierre soils are on back slopes. Slopes range from 9 to 25 percent. Typically, the surface layer is dark grayish brown, calcareous clay. Below this is a transitional layer of light brownish gray, calcareous clay. The subsoil also is light brownish gray, calcareous clay. It has masses of gypsum in the lower part. Light brownish gray and light olive gray shale bedrock is at a depth of about 27 inches. The shale is calcareous in the upper part.

Minor in this association are the Bullcreek, Kirley, Kyle, Lohmiller, Ottumwa, and Schamber soils and areas of Rock outcrop. The dense Bullcreek soils have salts in the subsoil and underlying material and are on the foot slopes of terraces and fans. The very deep, loamy Kirley soils are on the summits and back slopes of terraces. The dense Kyle soils are on the lower back slopes and on foot slopes. The stratified Lohmiller soils are on high flood plains. The very deep Ottumwa soils are on foot slopes at the higher elevations above the Samsil and Pierre soils. The gravelly Schamber soils are on summits and shoulder slopes.

Nearly all of this association supports native grasses and is used as range. Controlling erosion and maintaining the most productive grasses are the main management concerns. The major soils are suited to range. They generally are unsuited to cultivated crops and to tame pasture and hay because of the slope. Landslides are common because of the slope and the unstable nature of the underlying shale.

Nearly Level to Very Steep, Loamy and Clayey Soils on Undissected and Dissected Plains and on Terraces

These soils dominantly are gently sloping to moderately steep but are nearly level in some areas and steep or very steep in others. They make up about 13 percent of the county. About 85 percent of the acreage is range. Maintaining the most productive grasses is the main management concern.

14. Midway-Razor-Blackpipe Association

Shallow and moderately deep, well drained, nearly level to very steep, clayey and loamy soils on undissected and dissected plains

This association is characterized by prominent buttes, sharp ridges, hills, and nearly level plains. The soils formed in clayey shale residuum. Slopes generally are moderately sloping to very steep but are nearly level or gently sloping in some areas on the plains. The drainage pattern is well defined.

This association makes up about 3 percent of the county. It is about 38 percent Midway soils, 28 percent Razor soils, 20 percent Blackpipe soils, and 14 percent minor soils.

The shallow Midway soils are on shoulder slopes and the upper back slopes. Slopes range from 9 to 40 percent. Typically, the surface layer is light olive brown, calcareous silty clay loam. Below this is a transitional layer of light olive brown, calcareous clay. The underlying material is light yellowish brown, calcareous clay. Light yellowish brown and light gray, calcareous shale bedrock is at a depth of about 13 inches.

The moderately deep Razor soils are on back slopes. Slopes range from 2 to 15 percent. Typically, the surface layer is grayish brown silty clay. The subsoil is grayish brown, light olive brown, and light brownish gray, calcareous silty clay. Light yellowish brown, calcareous shale bedrock is at a depth of about 29 inches.

The moderately deep Blackpipe soils are on summits, back slopes, and foot slopes. Slopes range from 0 to 6 percent. Typically, the surface layer is gray silty clay loam. The subsoil is grayish brown and light brownish gray silty clay loam. It is calcareous in the lower part. Light yellowish brown and light brown, calcareous siltstone bedrock is at a depth of about 28 inches.

Minor in this association are the Lohmiller, Savo, Wanblee, and Wortman soils. The very deep, stratified Lohmiller soils are on high flood plains. The very deep Savo soils are on back slopes. The moderately deep, sodium-affected Wanblee and Wortman soils are on foot slopes.

About 90 percent of this association is range. The major soils are suited to range. Maintaining the most productive grasses is the main concern in managing range. Some areas are used for crops, mainly alfalfa and winter wheat, which are grown mostly on the Blackpipe soils. The Blackpipe soils are suited to cultivated crops and to tame pasture and hay, but the Midway and Razor soils generally are unsuited because of the slope.

15. Kirley-Lakoma-Vivian Association

Very deep, moderately deep, and deep, well drained and somewhat excessively drained, nearly level to steep, loamy and clayey soils on terraces and dissected plains

This association is characterized by gravelly breaks and buttes separated by deeply entrenched drainageways or nearly level terraces. Slopes dominantly are moderately sloping to moderately steep but are nearly level in some areas and steep in others. The drainage pattern is well defined.

This association makes up about 10 percent of the county. It is about 35 percent Kirley soils, 18 percent Lakoma soils, 12 percent Vivian soils, and 35 percent minor soils (fig. 4).

The very deep, well drained Kirley soils are on back slopes. Slopes range from 0 to 15 percent. Typically, the surface layer is dark grayish brown clay loam. The subsoil is dark grayish brown clay in the upper part and grayish brown and light brownish gray, calcareous clay and clay loam in the lower part. The underlying material is light brownish gray, calcareous clay loam.

The moderately deep, well drained Lakoma soils are on summits and back slopes. Slopes range from 6 to 30 percent. Typically, the surface layer is dark grayish brown, calcareous silty clay. The subsoil and the underlying material are grayish brown and light brownish gray, calcareous silty clay. Light gray, calcareous shale bedrock is at a depth of about 28 inches.

The deep, somewhat excessively drained Vivian soils are on the summits and shoulder slopes of terrace escarpments. Slopes range from 6 to 25 percent. Typically, the surface layer is grayish brown, calcareous gravelly loam. Below this is a transitional layer of light olive brown, calcareous gravelly loam. The underlying material is light yellowish brown, calcareous very gravelly loam. Light brownish gray, calcareous shale bedrock is at a depth of about 50 inches.

Minor in this association are the Canning, Capa, Hoven, Mosher, Okaton, Samsil, Schamber, and Wendte soils. The loamy Canning soils are 20 to 40 inches deep to sand and gravel and are on the upper back slopes and on shoulder slopes. The sodium-affected Capa and Mosher soils are on foot slopes. The poorly drained Hoven soils are in basins. The shallow Okaton and Samsil soils are on back slopes below the Vivian soils. The gravelly Schamber soils are in positions on the landscape

similar to those of the Vivian soils. The stratified Wendte soils are on high flood plains.

About 85 percent of this association is range. The major soils are suited to range. Maintaining the most productive grasses is the main concern in managing range. Some areas are used for crops, generally alfalfa and winter wheat, which are grown mostly on the Kirley soils. The Kirley soils are suited to cultivated crops and to tame pasture and hay, but the Lakoma and Vivian soils generally are unsuited because of the slope.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Nimbro silty clay loam, channeled, is a phase of the Nimbro series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Kirley-Mosher complex, 0 to 2 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Riverwash is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

The names of some map units identified on the detailed soil maps do not fully agree with those identified on the maps in the published surveys of Jackson, Pennington, and Stanley Counties. Differences are the result of variations in the design and composition of the map units or changes and refinements in series concepts.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

Ab—Albaton silty clay, depressional

Composition

Albaton and similar soils: 90 to 99 percent
Contrasting inclusions: 1 to 10 percent

Setting

Landform: Flood plains
Landform position: Low flood plains
Slope range: 0 to 1 percent
Shape of areas: Long and narrow
Size of areas: 10 to 80 acres

Typical Profile

Surface layer:
0 to 8 inches—dark gray, mottled, calcareous silty clay

Underlying layer:
8 to 60 inches—gray, mottled, calcareous silty clay

Soil Properties and Qualities

Drainage class: Very poorly drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Water table: 4 feet above to 2 feet below the surface
Flooding: Frequent, for brief periods
Ponding: None
Permeability: Very slow
Available water capacity: Moderate
Organic matter content: Moderate
Rate of surface runoff: Very low

Inclusions

Contrasting inclusions:
• The moderately well drained Wendte soils on high flood plains

Similar inclusions:
• Soils that have silty material within a depth of 40 inches
• Soils that have sandy material within a depth of 40 inches

Use and Management

Dominant uses: Most of the acreage is used as pasture, range, or wildlife habitat.

Cropland and pasture

Management consideration: This soil is poorly suited to cropland.
Management concerns: Wetness, compaction in areas that are grazed when wet, a high content of lime, which adversely affects the availability of plant nutrients, and wind erosion
Management measures:
• Restricting grazing during wet periods, maintaining proper stocking rates, and altering the season of use help to improve plant vigor, control wind erosion, and minimize compaction.

Interpretive Groups

*Land capability classification:*IVw-1
Range site: Clayey Overflow
Windbreak suitability group: 10
Pasture suitability group: B2

Ar—Arvada silt loam

Composition

Arvada and similar soils: 85 to 99 percent
Contrasting inclusions: 1 to 15 percent

Setting

Landform: Plains
Landform position: Foot slopes
Slope range: 0 to 4 percent
Shape of areas: Irregular
Size of areas: 20 to 250 acres

Typical Profile

Surface layer:
0 to 3 inches—light brownish gray silt loam

Subsoil:
3 to 9 inches—grayish brown clay
9 to 14 inches—grayish brown silty clay loam
14 to 43 inches—grayish brown, calcareous silty clay loam that has masses of gypsum and other salts

Underlying layer:
43 to 60 inches—grayish brown, calcareous silty clay loam that has masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Low
Organic matter content: Low
Rate of surface runoff: Medium
Other properties: The soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• Slickspots, which have salts at or near the surface and are on the lower foot slopes
• The well drained Ottumwa soils, which do not have a sodium-affected subsoil and are on the lower back slopes and on foot slopes

Similar inclusions:
• Soils that have a thicker dark surface layer

Use and Management

Rangeland

Management concerns: The limited available water capacity, a slow rate of water infiltration, and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration
Management measures:
• Proper grazing management helps to maintain plant vigor and conserves moisture.

Interpretive Groups

Land capability classification: VIs-1

Range site: Thin Claypan
Windbreak suitability group: 10
Pasture suitability group: NS

As—Arvada-Slickspots complex

Composition

Arvada and similar soils: 50 to 70 percent
Slickspots: 20 to 40 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Plains
Landform position: Arvada—foot slopes; Slickspots—the lower foot slopes
Slope range: Arvada—0 to 4 percent; Slickspots—0 to 2 percent
Shape of areas: Irregular
Size of areas: 20 to 150 acres

Typical Profile

Arvada

Surface layer:
0 to 3 inches—light brownish gray silt loam

Subsoil:
3 to 9 inches—grayish brown clay
9 to 14 inches—grayish brown silty clay loam
14 to 43 inches—grayish brown, calcareous silty clay loam that has masses of gypsum and other salts

Underlying layer:
43 to 60 inches—grayish brown, calcareous silty clay loam that has masses of gypsum and other salts

Characteristics of Slickspots

- A light gray, dispersed crust; a surface layer of clay; and dense, massive underlying material
- Accumulations of visible salts at or near the surface
- Barren or nearly barren of vegetation

Soil Properties and Qualities

Drainage class: Arvada—well drained; Slickspots—moderately well drained
Depth to bedrock: Arvada—very deep; Slickspots—very deep
Depth to a contrasting layer: Arvada—more than 60 inches; Slickspots—more than 60 inches
Depth to a high water table: Arvada—more than 6 feet; Slickspots—more than 6 feet
Flooding: Arvada—none; Slickspots—none
Ponding: Arvada—none; Slickspots—none
Permeability: Arvada—very slow; Slickspots—very slow
Available water capacity: Arvada—low; Slickspots—low
Organic matter content: Arvada—low; Slickspots—moderately low
Rate of surface runoff: Arvada—medium; Slickspots—medium
Other properties: The Arvada soil and Slickspots have a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
- The well drained Ottumwa soils, which do not have a sodium-affected subsoil and are on the lower back slopes and on foot slopes

Use and Management

Rangeland

Management concerns: Arvada—the sodium-affected subsoil, which adversely affects the availability of plant nutrients, a slow rate of water infiltration, and the limited available water capacity; Slickspots—the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration, a slow rate of water infiltration, the limited available water capacity, and the high content of salts in the subsoil
Management measures:
- Proper grazing management helps to maintain plant vigor and conserves moisture.

Interpretive Groups

Land capability classification: Arvada—VIs-1; Slickspots—VIIIs-3
Range site: Arvada—Thin Claypan; Slickspots—none
Windbreak suitability group: Arvada—10; Slickspots—10
Pasture suitability group: Arvada—NS; Slickspots—NS

Bc—Bankard loamy sand, hummocky

Composition

Bankard and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform: Flood plains
Landform position: High flood plains
Slope range: 0 to 6 percent
Shape of areas: Irregular or long and narrow
Size of areas: 20 to 200 acres

Typical Profile

Surface layer:
0 to 6 inches—grayish brown, calcareous loamy sand

Underlying layer:
6 to 60 inches—pale brown, calcareous sand

Soil Properties and Qualities

Drainage class: Somewhat excessively drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: Rare
Ponding: None
Permeability: Rapid
Available water capacity: Low
Organic matter content: Moderately low
Rate of surface runoff: Very low

Inclusions

Contrasting inclusions:
• The well drained Craft soils, which contain more silt than the Bankard soil and are in positions on the landscape similar to those of the Bankard soil

Similar inclusions:
• Soils that have a surface layer of very fine sandy loam, sandy loam, or loam

Use and Management

Rangeland

Management concerns: Wind erosion, the limited available water capacity, low fertility, and the formation of sand blowouts along livestock trails and around watering facilities
Management measures:
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
• Range seeding is needed on some sites.

Interpretive Groups

Land capability classification: VIe-8
Range site: Sands
Windbreak suitability group: 7
Pasture suitability group: NS

Bd—Bankard very fine sandy loam

Composition

Bankard and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Flood plains
Landform position: High flood plains
Slope range: 0 to 2 percent
Shape of areas: Irregular or long and narrow
Size of areas: 20 to 250 acres

Typical Profile

Surface layer:
0 to 10 inches—grayish brown, calcareous very fine sandy loam

Underlying layer:
10 to 60 inches—pale brown, calcareous sand

Soil Properties and Qualities

Drainage class: Somewhat excessively drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: Occasional, for brief periods
Ponding: None
Permeability: Rapid
Available water capacity: Low
Organic matter content: Moderately low
Rate of surface runoff: Very low

Inclusions

Contrasting inclusions:
• The well drained Craft soils, which contain more silt than the Bankard soil and are in positions on the landscape similar to those of the Bankard soil
• The well drained Haverson soils, which contain more clay than the Bankard soil and are on the lower parts of the landscape

Similar inclusions:
• Soils that have a surface layer of sandy loam or loam

Use and Management

Rangeland

Management concerns: The limited available water capacity and occasional flooding
Management measures:
• Proper grazing management helps to maintain plant vigor and conserves moisture.

Interpretive Groups

Land capability classification: VIe-8
Range site: Sandy
Windbreak suitability group: 5
Pasture suitability group: H

BkA—Blackpipe silty clay loam, 0 to 2 percent slopes

Composition

Blackpipe and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform: Plains
Landform position: Summits and back slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 1,000 acres

Typical Profile

Surface layer:
0 to 4 inches—gray silty clay loam

Subsoil:
4 to 17 inches—grayish brown silty clay loam
17 to 28 inches—light brownish gray, calcareous silty clay loam

Underlying layer:
28 to 60 inches—light yellowish brown and light brown, calcareous siltstone bedrock

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Moderately deep
Depth to contrasting parent material: 20 to 40 inches over siltstone bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: Low
Organic matter content: Moderate
Rate of surface runoff: Low

Inclusions

Contrasting inclusions:
• The moderately well drained Wanblee soils, which have a sodium-affected subsoil and are on the lower foot slopes
• The moderately well drained Wortman soils, which have a sodium-affected subsoil and are on foot slopes

Similar inclusions:
• Soils that do not have siltstone bedrock within a depth of 40 inches

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concerns: Few limitations, except for the need to conserve moisture
Management measures:
• Properly managing crop residue helps to conserve moisture and maintain the content of organic matter and tilth.

Interpretive Groups

Land capability classification: IIc-2
Range site: Silty
Windbreak suitability group: 6
Pasture suitability group: F

BkB—Blackpipe silty clay loam, 2 to 6 percent slopes

Composition

Blackpipe and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Plains
Landform position: Back slopes and foot slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 1,000 acres

Typical Profile

Surface layer:
0 to 4 inches—gray silty clay loam

Subsoil:
4 to 17 inches—grayish brown silty clay loam
17 to 28 inches—light brownish gray, calcareous silty clay loam

Underlying layer:
28 to 60 inches—light yellowish brown and light brown, calcareous siltstone bedrock

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Moderately deep
Depth to contrasting parent material: 20 to 40 inches over siltstone bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: Low
Organic matter content: Moderate
Rate of surface runoff: Medium

Inclusions

Contrasting inclusions:
• The moderately well drained Wanblee soils, which have a sodium-affected subsoil and are on the lower foot slopes

• The moderately well drained Wortman soils, which have a sodium-affected subsoil and are on foot slopes

Similar inclusions:
• Soils that do not have siltstone bedrock within a depth of 40 inches

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concern: Water erosion
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture and control erosion.
• Contour farming, grassed waterways, stripcropping, and field windbreaks help to control erosion.

Interpretive Groups

Land capability classification: IIe-1
Range site: Silty
Windbreak suitability group: 6
Pasture suitability group: F

Bo—Blackpipe-Wortman complex

Composition

Blackpipe and similar soils: 45 to 60 percent
Wortman and similar soils: 30 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Plains
Landform position: Blackpipe—back slopes; Wortman—foot slopes
Slope range: Blackpipe—0 to 4 percent; Wortman—0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 1,000 acres

Typical Profile

Blackpipe

Surface layer:
0 to 4 inches—gray silty clay loam

Subsoil:
4 to 17 inches—grayish brown silty clay loam
17 to 28 inches—light brownish gray, calcareous silty clay loam

Underlying layer:
28 to 60 inches—light yellowish brown and light brown, calcareous siltstone bedrock

Wortman

Surface layer:
0 to 5 inches—grayish brown silt loam

Subsoil:
5 to 8 inches—dark grayish brown clay
8 to 13 inches—grayish brown clay
13 to 18 inches—grayish brown, calcareous silty clay loam

Underlying layers:
18 to 36 inches—light olive brown, calcareous silty clay loam
36 to 60 inches—light reddish brown, calcareous siltstone bedrock

Soil Properties and Qualities

Drainage class: Blackpipe—well drained; Wortman—moderately well drained
Depth to bedrock: Blackpipe—moderately deep; Wortman—moderately deep
Depth to a contrasting layer: Blackpipe—20 to 40 inches over siltstone bedrock; Wortman—20 to 40 inches over siltstone bedrock
Depth to a high water table: Blackpipe—more than 6 feet; Wortman—more than 6 feet
Flooding: Blackpipe—none; Wortman—none
Ponding: Blackpipe—none; Wortman—none
Permeability: Blackpipe—moderately slow; Wortman—very slow
Available water capacity: Blackpipe—low; Wortman—low
Organic matter content: Blackpipe—moderate; Wortman—moderate
Rate of surface runoff: Blackpipe—medium; Wortman—medium
Other properties: The Wortman soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• The very deep, well drained Savo soils on back slopes below the Blackpipe soil
• The moderately well drained Wortman soils, which have a sodium-affected subsoil and are on foot slopes

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa

Management consideration: The Wortman soil is poorly suited to cropland.
Management concerns: Blackpipe—few limitations, except for the need to conserve moisture; Wortman—the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration, a slow rate of water infiltration, and the limited available water capacity
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface conserve moisture.
• Crop rotations that include grasses and legumes help to maintain the content of organic matter and improve tilth.
• Chiseling or subsoiling during dry periods increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Blackpipe—IIc-2; Wortman—IVs-2
Range site: Blackpipe—Silty; Wortman—Claypan
Windbreak suitability group: Blackpipe—6; Wortman—9
Pasture suitability group: Blackpipe—F; Wortman—C

Bu—Bullcreek clay, 0 to 6 percent slopes

Composition

Bullcreek and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Fans or terraces
Landform position: Foot slopes
Slope range: 0 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 250 acres

Typical Profile

Surface layer:
0 to 3 inches—dark grayish brown clay

Subsoil:
3 to 16 inches—grayish brown, calcareous clay
16 to 26 inches—olive, calcareous clay that has masses of gypsum and other salts

Underlying layer:
26 to 60 inches—olive, calcareous clay that has masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Well drained and moderately well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Low
Organic matter content: Moderately low
Rate of surface runoff: Medium
Other properties: The soil has a high content of salts.

Inclusions

Contrasting inclusions:
• The moderately well drained Capa soils, which have a sodium-affected subsoil and are on the lower foot slopes
• The very poorly drained Herdcamp soils on the lowest part of flood plains
• The well drained Promise soils, which do not have visible salts within a depth of 20 inches and are on the lower back slopes and on foot slopes
• The poorly drained Egas soils, which have visible salts within a depth of 6 inches and are on low flood plains

Similar inclusions:
• Soils that have shale bedrock within a depth of 40 inches

Use and Management

Rangeland

Management concerns: A slow rate of water infiltration, the limited available water capacity, the high content of salts, and wind erosion
Management measures:
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.

Interpretive Groups

Land capability classification: VIs-5
Range site: Dense Clay
Windbreak suitability group: 10
Pasture suitability group: NS

Bx—Bullcreek-Slickspots complex

Composition

Bullcreek and similar soils: 55 to 70 percent
Slickspots: 30 to 40 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform: Fans or terraces
Landform position: Bullcreek—foot slopes; Slickspots—the lower foot slopes
Slope range: Bullcreek—0 to 2 percent; Slickspots—0 to 2 percent
Shape of areas: Irregular

Size of areas: 10 to 200 acres

Typical Profile

Bullcreek

Surface layer:
0 to 3 inches—dark grayish brown clay

Subsoil:
3 to 16 inches—grayish brown, calcareous clay
16 to 26 inches—olive, calcareous clay that has masses of gypsum and other salts

Underlying layer:
26 to 60 inches—olive, calcareous clay that has masses of gypsum and other salts

Characteristics of Slickspots

- A light gray, dispersed crust; a surface layer of clay; and dense, massive underlying material
- Accumulations of visible salts at or near the surface
- Barren or nearly barren of vegetation

Soil Properties and Qualities

Drainage class: Bullcreek—well drained and moderately well drained; Slickspots—moderately well drained
Depth to bedrock: Bullcreek—very deep; Slickspots—very deep
Depth to a contrasting layer: Bullcreek—more than 60 inches; Slickspots—more than 60 inches
Depth to a high water table: Bullcreek—more than 6 feet; Slickspots—more than 6 feet
Flooding: Bullcreek—none; Slickspots—none
Ponding: Bullcreek—none; Slickspots—none
Permeability: Bullcreek—very slow; Slickspots—very slow
Available water capacity: Bullcreek—low; Slickspots—low
Organic matter content: Bullcreek—moderately low; Slickspots—moderately low
Rate of surface runoff: Bullcreek—medium; Slickspots—medium
Other properties: The Bullcreek soil and the Slickspots have a high content of salts.

Inclusions

Contrasting inclusions:
- The moderately well drained Capa soils, which have a sodium-affected subsoil and are on the lower foot slopes
- The very poorly drained Herdcamp soils on the lowest part of flood plains
- The poorly drained Egas soils, which have visible salts within a depth of 6 inches and are on low flood plains

Similar inclusions:
- Soils that have shale bedrock within a depth of 40 inches

Use and Management

Rangeland

Management concerns: A slow rate of water infiltration, the limited available water capacity, the high content of salts, and wind erosion
Management measures:
- Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.

Interpretive Groups

Land capability classification: Bullcreek—VIs-5; Slickspots—VIIIs-3
Range site: Bullcreek—Dense Clay; Slickspots—none
Windbreak suitability group: Bullcreek—10; Slickspots—10
Pasture suitability group: Bullcreek—NS; Slickspots—NS

Ca—Canning loam

Composition

Canning and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Terraces
Landform position: Summits and back slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 20 to 200 acres

Typical Profile

Surface layer:
0 to 6 inches—dark grayish brown loam

Subsoil:
6 to 18 inches—dark grayish brown and brown clay loam
18 to 27 inches—pale brown, calcareous gravelly loam

Underlying layer:
27 to 60 inches—light yellowish brown, calcareous gravelly fine sand and medium sand

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: 20 to 40 inches over sand and gravel
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Moderate in the solum and rapid in the underlying material
Available water capacity: Low

Organic matter content: Moderate
Rate of surface runoff: Low

Inclusions

Contrasting inclusions:
• The moderately well drained Onita soils, which are dark to a depth of more than 20 inches and are on foot slopes

Similar inclusions:
• Soils that do not have sand and gravel within a depth of 40 inches
• Soils that contain more clay

Use and Management

Cropland

Main crops: Winter wheat, oats, grain sorghum, and alfalfa
Management concern: The limited available water capacity
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface conserve moisture.

Interpretive Groups

Land capability classification: IIIs-2
Range site: Silty
Windbreak suitability group: 6
Pasture suitability group: D1

CbA—Capa silt loam, 0 to 6 percent slopes

Composition

Capa and similar soils: 85 to 99 percent
Contrasting inclusions: 1 to 15 percent

Setting

Landform: Plains
Landform position: Foot slopes
Slope range: 0 to 6 percent
Shape of areas: Irregular
Size of areas: 15 to 100 acres

Typical Profile

Surface layer:
0 to 2 inches—gray silt loam

Subsoil:
2 to 7 inches—grayish brown clay
7 to 14 inches—grayish brown, calcareous clay
14 to 20 inches—grayish brown, calcareous clay that has masses of gypsum and other salts
20 to 28 inches—grayish brown, calcareous silty clay that has masses of gypsum and other salts

Underlying layers:
28 to 52 inches—grayish brown, calcareous silty clay that has masses of gypsum and other salts
52 to 60 inches—grayish brown, calcareous silty clay

Soil Properties and Qualities

Drainage class: Moderately well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: 3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Low
Organic matter content: Moderately low
Rate of surface runoff: Medium
Other properties: The soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• Slickspots, which have salts at or near the surface and are on the lower foot slopes
• The well drained Ottumwa soils, which do not have a sodium-affected subsoil and are on the lower foot slopes
• The well drained Promise soils, which do not have a sodium-affected subsoil and are on the upper foot slopes
• The well drained and moderately well drained Bullcreek soils, which do not have a sodium-affected subsoil and are in positions on the landscape similar to those of the Capa soil

Similar inclusions:
• Soils that have shale bedrock at a depth of 40 to 60 inches

Use and Management

Rangeland

Management concerns: The sodium-affected subsoil, which adversely affects plant growth by restricting root penetration, the limited available water capacity, and a slow rate of water infiltration
Management measures:
• Proper grazing management helps to maintain plant vigor and conserves moisture.

Interpretive Groups

Land capability classification: VIs-1
Range site: Thin Claypan
Windbreak suitability group: 10

Pasture suitability group: NS

Cc—Capa-Slickspots complex

Composition

Capa and similar soils: 50 to 60 percent
Slickspots: 30 to 40 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Plains
Landform position: Capa—foot slopes; Slickspots—the lower foot slopes
Slope range: Capa—0 to 3 percent; Slickspots—0 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 75 acres

Typical Profile

Capa

Surface layer:
0 to 2 inches—gray silt loam

Subsoil:
2 to 7 inches—grayish brown clay
7 to 14 inches—grayish brown, calcareous clay
14 to 20 inches—grayish brown, calcareous clay that has masses of gypsum and other salts
20 to 28 inches—grayish brown, calcareous silty clay that has masses of gypsum and other salts

Underlying layers:
28 to 52 inches—grayish brown, calcareous silty clay that has masses of gypsum and other salts
52 to 60 inches—grayish brown, calcareous silty clay

Characteristics of Slickspots

• A light gray, dispersed crust; a surface layer of clay; and dense, massive underlying material
• Accumulations of visible salts at or near the surface
• Barren or nearly barren of vegetation

Soil Properties and Qualities

Drainage class: Capa—moderately well drained; Slickspots—moderately well drained
Depth to bedrock: Capa—very deep; Slickspots—very deep
Depth to a contrasting layer: Capa—more than 60 inches; Slickspots—more than 60 inches
Depth to a high water table: Capa—3.5 to 5.0 feet; Slickspots—more than 6.0 feet
Flooding: Capa—none; Slickspots—none
Ponding: Capa—none; Slickspots—none
Permeability: Capa—very slow; Slickspots—very slow
Available water capacity: Capa—low; Slickspots—low
Organic matter content: Capa—moderately low; Slickspots—moderately low
Rate of surface runoff: Capa—medium; Slickspots—medium
Other properties: The Capa soil and Slickspots have a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• The well drained Promise soils, which do not have a sodium-affected subsoil and are on the upper foot slopes
• The well drained and moderately well drained Bullcreek soils, which do not have a sodium-affected subsoil and are in positions on the landscape similar to those of the Capa soil

Similar inclusions:
• Soils that have shale bedrock at a depth of 40 to 60 inches

Use and Management

Rangeland

Management concerns: Capa—the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration, the limited available water capacity, and a slow rate of water infiltration; Slickspots—the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration, the limited available water capacity, a slow rate of water infiltration, and the high content of salts in the subsoil
Management measures:
• Proper grazing management helps to maintain plant vigor and conserves moisture.

Interpretive Groups

Land capability classification: Capa—VIs-1; Slickspots—VIIIs-3
Range site: Capa—Thin Claypan; Slickspots—none
Windbreak suitability group: Capa—10; Slickspots—10
Pasture suitability group: Capa—NS; Slickspots—NS

Ct—Capa-Wendte, channeled, complex

Composition

Capa and similar soils: 60 to 65 percent
Wendte and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Plains and flood plains

Landform position: Capa—foot slopes; Wendte—high flood plains
Slope range: Capa—0 to 4 percent; Wendte—0 to 2 percent
Shape of areas: Long and narrow
Size of areas: 25 to 300 acres

Typical Profile

Capa

Surface layer:
0 to 2 inches—gray silt loam

Subsoil:
2 to 7 inches—grayish brown clay
7 to 14 inches—grayish brown, calcareous clay
14 to 20 inches—grayish brown, calcareous clay that has masses of gypsum and other salts
20 to 28 inches—grayish brown, calcareous silty clay that has masses of gypsum and other salts

Underlying layers:
28 to 52 inches—grayish brown, calcareous silty clay that has masses of gypsum and other salts
52 to 60 inches—grayish brown, calcareous silty clay

Wendte

Surface layer:
0 to 6 inches—grayish brown, calcareous silty clay

Underlying layers:
6 to 42 inches—grayish brown, calcareous, stratified clay
42 to 60 inches—light brownish gray, calcareous, stratified silty clay loam

Soil Properties and Qualities

Drainage class: Capa—moderately well drained; Wendte—moderately well drained
Depth to bedrock: Capa—very deep; Wendte—very deep
Depth to a contrasting layer: Capa—more than 60 inches; Wendte—more than 60 inches
Depth to a high water table: Capa—3.5 to 5.0 feet; Wendte—3.5 to 5.0 feet
Flooding: Capa—none; Wendte—occasional, for brief periods
Ponding: Capa—none; Wendte—none
Permeability: Capa—very slow; Wendte—slow
Available water capacity: Capa—low; Wendte—moderate
Organic matter content: Capa—moderately low; Wendte—moderate
Rate of surface runoff: Capa—medium; Wendte—low
Other properties: The Capa soil has a sodium-affected subsoil. The Wendte soil is typically dissected by meandering stream channels.

Inclusions

Contrasting inclusions:
- The well drained Ottumwa soils on the lower foot slopes
- The very poorly drained Herdcamp soils on low flood plains
- Slickspots, which have salts at or near the surface and are on the lower foot slopes

Use and Management

Rangeland

Management concerns: Capa—the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration, the limited available water capacity, and a slow rate of water infiltration; Wendte—wind erosion, a slow rate of water infiltration, meandering channels, and compaction in areas that are grazed when wet
Management measures:
- Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.

Interpretive Groups

Land capability classification: Capa—VIs-1; Wendte—VIw-1
Range site: Capa—Thin Claypan; Wendte—Clayey Overflow
Windbreak suitability group: Capa—10; Wendte—4
Pasture suitability group: Capa—NS; Wendte—NS

Cv—Craft very fine sandy loam

Composition

Craft and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Flood plains
Landform position: High flood plains
Slope range: 0 to 2 percent
Shape of areas: Irregular or long and narrow
Size of areas: 10 to 150 acres

Typical Profile

Surface layer:
0 to 5 inches—grayish brown, calcareous very fine sandy loam

Underlying layer:
5 to 60 inches—light brownish gray, calcareous silt loam and very fine sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: Rare
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: Low
Rate of surface runoff: Low
Other properties: The soil has a high content of lime.

Inclusions

Contrasting inclusions:
- The clayey Lohmiller soils in the slightly lower landscape positions
- The sandy Bankard soils on the slightly higher flood plains

Similar inclusions:
- Soils that contain more clay throughout
- Soils that have a surface layer of silty clay loam

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, forage sorghum, oats, corn, and alfalfa (fig. 8)
Management concerns: Wind erosion and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
- Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control wind erosion.
- Crop rotations that include grasses and legumes help to control wind erosion and maintain the content of organic matter, fertility, and tilth.
- Field windbreaks help to control wind erosion.

Interpretive Groups

Land capability classification: IIc-1
Range site: Loamy Terrace
Windbreak suitability group: 1
Pasture suitability group: F

Eg—Egas silty clay loam

Composition

Egas and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform: Flood plains
Landform position: Low flood plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 5 to 100 acres

Typical Profile

Surface layer:
0 to 6 inches—grayish brown, calcareous silty clay loam

Transitional layer:
6 to 11 inches—grayish brown, calcareous silty clay that has masses of salts

Underlying layer:
11 to 60 inches—grayish brown, calcareous silty clay loam that has disseminated salts

Soil Properties and Qualities

Drainage class: Poorly drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: 0 to 1.5 feet
Flooding: Occasional, for brief periods
Ponding: None
Permeability: Slow
Available water capacity: Low
Organic matter content: Moderate
Rate of surface runoff: Low
Other properties: The soil has a high content of salts.

Inclusions

Contrasting inclusions:
- The well drained Arvada soils, which have a sodium-affected subsoil and are on foot slopes
- The well drained Ottumwa soils, which do not have visible salts within a depth of 6 inches and are on the lower foot slopes on the outer edge of the map unit
- The very poorly drained Herdcamp soils, which have a lower content of salts throughout than the Egas soil and are slightly lower on the landscape

Use and Management

Rangeland

Management concerns: A high content of lime, which adversely affects the availability of plant nutrients, the high content of salts, wetness, the limited available water capacity, and compaction in areas that are grazed when wet
Management measures:
- Restricting grazing during wet periods, maintaining proper stocking rates, and altering the season of use improve plant vigor and minimize compaction.

Figure 8.—An area of Craft very fine sandy loam used as cropland.

Interpretive Groups

Land capability classification: VIs-1
Range site: Saline Lowland
Windbreak suitability group: 10
Pasture suitability group: J

Ha—Haverson silt loam

Composition

Haverson and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform: Flood plains
Landform position: High flood plains
Slope range: 0 to 2 percent
Shape of areas: Long and narrow
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 4 inches—grayish brown silt loam

Subsurface layer:
4 to 12 inches—grayish brown and dark grayish brown, calcareous silt loam

Underlying layer:
12 to 60 inches—light olive brown and light yellowish brown, calcareous silty clay loam stratified with thin lenses of fine sandy loam and fine sand

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: Rare
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderately low
Rate of surface runoff: Low

Inclusions

Contrasting inclusions:
• The somewhat excessively drained Bankard soils, which contain more sand throughout than the Haverson

soil and are in positions on the landscape similar to those of the Haverson soil
• The clayey Lohmiller soils in the slightly lower landscape positions

Similar inclusions:
• Soils that contain more silt throughout

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, forage sorghum, oats, corn, and alfalfa
Management concerns: Conserving moisture and controlling wind erosion
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control wind erosion.

Interpretive Groups

Land capability classification: IIc-1
Range site: Loamy Terrace
Windbreak suitability group: 1
Pasture suitability group: F

Hb—Haverson silt loam, channeled

Composition

Haverson and similar soils: 80 to 99 percent
Contrasting inclusions: 1 to 20 percent

Setting

Landform: Flood plains
Landform position: High flood plains
Slope range: 0 to 2 percent
Shape of areas: Long and narrow
Size of areas: 10 to 250 acres

Typical Profile

Surface layer:
0 to 4 inches—grayish brown silt loam

Subsurface layer:
4 to 12 inches—grayish brown and dark grayish brown, calcareous silt loam

Underlying layer:
12 to 60 inches—light olive brown and light yellowish brown, calcareous silty clay loam stratified with thin lenses of fine sandy loam and fine sand

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: Frequent, for brief periods
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderately low
Rate of surface runoff: Low

Inclusions

Contrasting inclusions:
• The well drained Lohmiller soils, which contain more clay throughout than the Haverson soil and are in the slightly lower landscape positions
• The well drained Arvada soils, which have a sodium-affected subsoil and are on foot slopes on plains

Similar inclusions:
• Soils that contain less clay throughout

Use and Management

Rangeland

Management concerns: Meandering channels and wetness
Management measures:
• Restricting grazing during wet periods, maintaining proper stocking rates, and altering the season of use improve plant vigor and minimize compaction.

Interpretive Groups

Land capability classification: VIw-1
Range site: Loamy Overflow
Windbreak suitability group: 1
Pasture suitability group: NS

Hc—Haverson-Craft complex

Composition

Haverson and similar soils: 45 to 55 percent
Craft and similar soils: 35 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Flood plains
Landform position: Haverson—high flood plains; Craft—high flood plains
Slope range: Haverson—0 to 2 percent; Craft—0 to 2 percent
Shape of areas: Irregular or long and narrow
Size of areas: 10 to 400 acres

Typical Profile

Haverson

Surface layer:
0 to 4 inches—grayish brown silt loam

Subsurface layer:
4 to 12 inches—grayish brown and dark grayish brown, calcareous silt loam

Underlying layer:
12 to 60 inches—light olive brown and light yellowish brown, calcareous silty clay loam stratified with thin lenses of fine sandy loam and fine sand

Craft

Surface layer:
0 to 5 inches—grayish brown, calcareous very fine sandy loam

Underlying layer:
5 to 60 inches—light brownish gray, calcareous silt loam and very fine sandy loam

Soil Properties and Qualities

Drainage class: Haverson—well drained; Craft—well drained
Depth to bedrock: Haverson—very deep; Craft—very deep
Depth to a contrasting layer: Haverson—more than 60 inches; Craft—more than 60 inches
Depth to a high water table: Haverson—more than 6 feet; Craft—more than 6 feet
Flooding: Haverson—rare; Craft—rare
Ponding: Haverson—none; Craft—none
Permeability: Haverson—moderate; Craft—moderate
Available water capacity: Haverson—high; Craft—high
Organic matter content: Haverson—moderately low; Craft—low
Rate of surface runoff: Haverson—low; Craft—low

Inclusions

Contrasting inclusions:
• The moderately well drained Hilmoe soils, which contain more clay in the upper part than the Haverson and Craft soils and are in positions on the landscape similar to those of the Haverson soil
• The somewhat excessively drained Bankard soils, which contain more sand throughout than the Haverson and Craft soils and are in positions on the landscape similar to those of the Craft soil

Similar inclusions:
• Soils that have a darker surface layer

Use and Management

Cropland

Main crops: Winter wheat, forage sorghum, oats, and alfalfa
Management concerns: Few limitations, except for the need to conserve moisture and control wind erosion
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control wind erosion.

Interpretive Groups

Land capability classification: Haverson—IIc-1; Craft—IIc-1
Range site: Haverson—Loamy Terrace; Craft—Loamy Terrace
Windbreak suitability group: Haverson—1; Craft—1
Pasture suitability group: Haverson—F; Craft—F

Ho—Hilmoe silty clay

Composition

Hilmoe and similar soils: 80 to 95 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Flood plains
Landform position: Low flood plains
Slope range: 0 to 2 percent
Shape of areas: Long and narrow
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 6 inches—gray, calcareous silty clay

Transitional layer:
6 to 15 inches—gray, calcareous silty clay

Underlying layers:
15 to 37 inches—gray and light gray, calcareous silty clay and clay loam having masses of gypsum and other salts
37 to 60 inches—light brownish gray, calcareous fine sandy loam that is stratified with thin lenses of finer textured material and has a few masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Moderately well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: 20 to 40 inches over silty alluvium

Depth to a high water table: More than 6 feet
Flooding: Rare
Ponding: None
Permeability: Slow
Available water capacity: High
Organic matter content: Moderate
Rate of surface runoff: Low

Inclusions

Contrasting inclusions:
• The well drained and moderately well drained Bullcreek soils, which have visible salts within a depth of 20 inches and are on foot slopes
• The well drained Craft soils, which have a sodium-affected subsoil and are in the slightly higher positions on the landscape

Similar inclusions:
• Soils having clayey material that extends below a depth of 40 inches
• Soils that have a silty surface layer about 15 inches thick

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, forage sorghum, corn, and alfalfa
Management concerns: Wind erosion and a high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control wind erosion.
• Crop rotations that include grasses and legumes help to control wind erosion and maintain the content of organic matter, fertility, and tilth.
• Field windbreaks help to control wind erosion.

Interpretive Groups

Land capability classification: IIIs-3
Range site: Clayey Overflow
Windbreak suitability group: 4
Pasture suitability group: I

HpB—Hisle silt loam, 0 to 6 percent slopes

Composition

Hisle and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform: Plains
Landform position: Foot slopes
Slope range: 0 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 25 acres

Typical Profile

Surface layer:
0 to 2 inches—grayish brown silt loam

Subsoil:
2 to 15 inches—brown, calcareous silty clay
15 to 21 inches—pale brown, calcareous silty clay

Underlying layers:
21 to 28 inches—pale brown, calcareous silty clay
28 to 60 inches—light gray, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Moderately deep
Depth to contrasting parent material: 20 to 40 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Very low
Organic matter content: Moderately low
Rate of surface runoff: High
Other properties: The soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• The very deep Kyle soils, which do not have a sodium-affected subsoil and are on the upper foot slopes
• The very deep Ottumwa soils, which do not have a sodium-affected subsoil, have less clay than the Kyle soil, and are on foot slopes
• The moderately deep Pierre soils, which do not have a sodium-affected subsoil and are on back slopes

Similar inclusions:
• Soils that do not have shale bedrock within a depth of 40 inches

Use and Management

Rangeland

Management concerns: The sodium-affected subsoil, which adversely affects plant growth by restricting root penetration, the limited available water capacity, and a slow rate of water infiltration
Management measures:
• Proper grazing management helps to maintain plant vigor and conserves moisture

Interpretive Groups

Land capability classification: VIs-3
Range site: Thin Claypan
Windbreak suitability group: 10
Pasture suitability group: NS

Hv—Hoven silt loam

Composition

Hoven and similar soils: 90 to 99 percent
Contrasting inclusions: 1 to 10 percent

Setting

Landform: Plains
Landform position: Basins
Slope range: 0 to 1 percent
Shape of areas: Circular or oblong
Size of areas: 10 to 60 acres

Typical Profile

Surface layer:
0 to 3 inches—gray silt loam

Subsoil:
3 to 23 inches—dark gray silty clay
23 to 33 inches—dark gray, calcareous silty clay

Underlying layers:
33 to 45 inches—grayish brown, calcareous silty clay that has a few masses of gypsum and other salts
45 to 60 inches—grayish brown, calcareous silty clay that has many masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Poorly drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Water table: 1.0 foot above to 1.5 feet below the surface
Flooding: None
Ponding: Occasional, for long periods
Permeability: Very slow
Available water capacity: Moderate
Organic matter content: Moderate
Rate of surface runoff: Negligible

Inclusions

Contrasting inclusions:
• The moderately well drained Capa soils, which have a sodium-affected subsoil and are on foot slopes

Similar inclusions:
• Soils that do not have a sodium-affected subsoil

Use and Management

Rangeland

Management concerns: Wetness and compaction in areas that are grazed when wet
Management measures:
• Restricting grazing during wet periods, maintaining proper stocking rates, and altering the season of use improve plant vigor and minimize compaction.

Interpretive Groups

Land capability classification: VIs-1
Range site: Closed Depression
Windbreak suitability group: 10
Pasture suitability group: B2

KeA—Kirley clay loam, 0 to 2 percent slopes

Composition

Kirley and similar soils: 90 to 99 percent
Contrasting inclusions: 1 to 10 percent

Setting

Landform: Terraces
Landform position: Summits and back slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 300 acres

Typical Profile

Surface layer:
0 to 5 inches—dark grayish brown clay loam

Subsoil:
5 to 13 inches—dark grayish brown clay
13 to 21 inches—grayish brown, calcareous clay
21 to 34 inches—light brownish gray, calcareous clay loam

Underlying layer:
34 to 60 inches—light brownish gray, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderate
Rate of surface runoff: Low

Inclusions

Contrasting inclusions:
• The poorly drained Kolls soils in basins
• The moderately well drained Mosher soils, which have a sodium-affected subsoil and are on the lower foot slopes

Similar inclusions:
• Soils that contain less clay in the subsoil

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concerns: Few limitations, except for the need to conserve moisture
Management measures:
• Properly managing crop residue helps to conserve moisture and maintain the content of organic matter and tilth.

Interpretive Groups

Land capability classification: IIc-2
Range site: Clayey
Windbreak suitability group: 3
Pasture suitability group: F

KeB—Kirley clay loam, 2 to 6 percent slopes

Composition

Kirley and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Terraces
Landform position: Back slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 400 acres

Typical Profile

Surface layer:
0 to 5 inches—dark grayish brown clay loam

Subsoil:
5 to 13 inches—dark grayish brown clay
13 to 21 inches—grayish brown, calcareous clay
21 to 34 inches—light brownish gray, calcareous clay loam

Underlying layer:
34 to 60 inches—light brownish gray, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderate
Rate of surface runoff: Medium

Inclusions

Contrasting inclusions:
• The moderately deep Lakoma soils, which contain more clay throughout than the Kirley soil and are on the higher back slopes
• The moderately well drained Mosher soils, which have a sodium-affected subsoil and are on the lower foot slopes

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concern: Water erosion
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control water erosion.
• Stripcropping, contour farming, and grassed waterways help to control water erosion.

Interpretive Groups

Land capability classification: IIe-1
Range site: Clayey
Windbreak suitability group: 3
Pasture suitability group: F

KeD—Kirley clay loam, 6 to 15 percent slopes

Composition

Kirley and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Terraces
Landform position: Shoulder slopes and back slopes
Slope range: 6 to 15 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Surface layer:
0 to 5 inches—dark grayish brown clay loam

Subsoil:
5 to 13 inches—dark grayish brown clay
13 to 21 inches—grayish brown, calcareous clay
21 to 34 inches—light brownish gray, calcareous clay loam

Underlying layer:
34 to 60 inches—light brownish gray, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderate
Rate of surface runoff: High or very high

Inclusions

Contrasting inclusions:
• The moderately deep Lakoma soils, which contain more clay throughout than the Kirley soil and are on the upper back slopes
• The moderately well drained Mosher soils, which have a sodium-affected subsoil and are on the lower foot slopes
• The well drained Ottumwa soils, which contain more clay throughout than the Kirley soil and are on foot slopes

Similar inclusions:
• Soils that contain less clay in the subsoil

Use and Management

Cropland and pasture

Main crops: Winter wheat, oats, and alfalfa
Management consideration: This soil is poorly suited to cropland.
Management concern: Water erosion
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control water erosion.
• Stripcropping, contour farming, and grassed waterways help to control water erosion.

Interpretive Groups

Land capability classification: IVe-1
Range site: Clayey
Windbreak suitability group: 3
Pasture suitability group: F

KfB—Kirley-Canning complex, 2 to 6 percent slopes

Composition

Kirley and similar soils: 45 to 65 percent
Canning and similar soils: 25 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Terraces
Landform position: Kirley—back slopes; Canning—summits and shoulder slopes
Slope range: Kirley—2 to 6 percent; Canning—2 to 6 percent
Shape of areas: Irregular
Size of areas: 20 to 200 acres

Typical Profile

Kirley

Surface layer:
0 to 5 inches—dark grayish brown clay loam

Subsoil:
5 to 13 inches—dark grayish brown clay
13 to 21 inches—grayish brown, calcareous clay
21 to 34 inches—light brownish gray, calcareous clay loam

Underlying layer:
34 to 60 inches—light brownish gray, calcareous clay loam

Canning

Surface layer:
0 to 6 inches—dark grayish brown loam

Subsoil:
6 to 18 inches—dark grayish brown and brown clay loam
18 to 27 inches—pale brown, calcareous gravelly loam

Underlying layer:
27 to 60 inches—light yellowish brown, calcareous gravelly fine sand and medium sand

Soil Properties and Qualities

Drainage class: Kirley—well drained; Canning—well drained
Depth to bedrock: Kirley—very deep; Canning—very deep
Depth to a contrasting layer: Kirley—more than 60 inches; Canning—20 to 40 inches over sand and gravel

Depth to a high water table: Kirley—more than 6 feet; Canning—more than 6 feet
Flooding: Kirley—none; Canning—none
Ponding: Kirley—none; Canning—none
Permeability: Kirley—moderately slow; Canning—moderate in the solum and rapid in the underlying material
Available water capacity: Kirley—high; Canning—low
Organic matter content: Kirley—moderate; Canning—moderate
Rate of surface runoff: Kirley—medium; Canning—medium

Inclusions

Contrasting inclusions:
• The moderately well drained Onita soils, which are dark to a depth of more than 20 inches and are on foot slopes
• The somewhat excessively drained Vivian soils, which have gravelly material within a depth of 10 inches and are on summits and shoulder slopes

Similar inclusions:
• Soils that contain more clay

Use and Management

Cropland

Main crops: Winter wheat, oats, grain sorghum, and alfalfa
Management concerns: Kirley—water erosion; Canning—water erosion and the limited available water capacity
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control erosion.
• Stripcropping, contour farming, and grassed waterways help to control water erosion.

Interpretive Groups

Land capability classification: Kirley—IIe-1; Canning—IIIe-6
Range site: Kirley—Clayey; Canning—Silty
Windbreak suitability group: Kirley—3; Canning—6
Pasture suitability group: Kirley—F; Canning—D1

KhA—Kirley-Mosher complex, 0 to 2 percent slopes

Composition

Kirley and similar soils: 55 to 70 percent
Mosher and similar soils: 20 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Terraces
Landform position: Kirley—back slopes; Mosher—foot slopes
Slope range: Kirley—0 to 2 percent; Mosher—0 to 2 percent
Shape of areas: Irregular
Size of areas: 20 to 200 acres

Typical Profile

Kirley

Surface layer:
0 to 5 inches—dark grayish brown clay loam

Subsoil:
5 to 13 inches—dark grayish brown clay
13 to 21 inches—grayish brown, calcareous clay
21 to 34 inches—light brownish gray, calcareous clay loam

Underlying layer:
34 to 60 inches—light brownish gray, calcareous clay loam

Mosher

Surface layer:
0 to 3 inches—grayish brown silt loam

Subsurface layer:
3 to 6 inches—light brownish gray silt loam

Subsoil:
6 to 18 inches—dark grayish brown clay
18 to 26 inches—grayish brown, calcareous clay loam that has threads of salts

Underlying layer:
26 to 60 inches—pale brown, calcareous loam

Soil Properties and Qualities

Drainage class: Kirley—well drained; Mosher—moderately well drained
Depth to bedrock: Kirley—very deep; Mosher—very deep
Depth to a contrasting layer: Kirley—more than 60 inches; Mosher—more than 60 inches
Depth to a high water table: Kirley—more than 6.0 feet; Mosher—3.5 to 5.0 feet
Flooding: Kirley—none; Mosher—none
Ponding: Kirley—none; Mosher—none
Permeability: Kirley—moderately slow; Mosher—very slow
Available water capacity: Kirley—high; Mosher—moderate
Organic matter content: Kirley—moderate; Mosher—moderately low
Rate of surface runoff: Kirley—low; Mosher—medium

Other properties: The Mosher soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• The moderately well drained Capa soils, which have visible salts within a depth of 16 inches and are on the lower foot slopes

Similar inclusions:
• Soils that contain less clay in the subsoil than the Kirley soil

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management consideration: The Mosher soil is poorly suited to cropland.
Management concerns: Kirley—few limitations, except for the need to conserve moisture; Mosher—the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration, and a slow rate of water infiltration
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface conserve moisture.
• Crop rotations that include grasses and legumes help to maintain the content of organic matter and improve tilth.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Kirley—IIc-2; Mosher—IVs-2
Range site: Kirley—Clayey; Mosher—Claypan
Windbreak suitability group: Kirley—3; Mosher—9
Pasture suitability group: Kirley—F; Mosher—C

KhB—Kirley-Mosher complex, 2 to 6 percent slopes

Composition

Kirley and similar soils: 60 to 75 percent
Mosher and similar soils: 15 to 35 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Terraces
Landform position: Kirley—back slopes; Mosher—foot slopes
Slope range: Kirley—2 to 6 percent; Mosher—2 to 6 percent
Shape of areas: Irregular
Size of areas: 15 to 250 acres

Typical Profile

Kirley

Surface layer:
0 to 5 inches—dark grayish brown clay loam

Subsoil:
5 to 13 inches—dark grayish brown clay
13 to 21 inches—grayish brown, calcareous clay
21 to 34 inches—light brownish gray, calcareous clay loam

Underlying layer:
34 to 60 inches—light brownish gray, calcareous clay loam

Mosher

Surface layer:
0 to 3 inches—grayish brown silt loam

Subsurface layer:
3 to 6 inches—light brownish gray silt loam

Subsoil:
6 to 18 inches—dark grayish brown clay
18 to 26 inches—grayish brown, calcareous clay loam that has threads of salts

Underlying layer:
26 to 60 inches—pale brown, calcareous loam

Soil Properties and Qualities

Drainage class: Kirley—well drained; Mosher—moderately well drained
Depth to bedrock: Kirley—very deep; Mosher—very deep
Depth to a contrasting layer: Kirley—more than 60 inches; Mosher—more than 60 inches
Depth to a high water table: Kirley—more than 6.0 feet; Mosher—3.5 to 5.0 feet
Flooding: Kirley—none; Mosher—none
Ponding: Kirley—none; Mosher—none
Permeability: Kirley—moderately slow; Mosher—very slow
Available water capacity: Kirley—high; Mosher—moderate
Organic matter content: Kirley—moderate; Mosher—moderately low
Rate of surface runoff: Kirley—medium; Mosher—high
Other properties: The Mosher soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• The moderately well drained Capa soils, which have

visible salts within a depth of 16 inches and are on the lower foot slopes

Similar inclusions:
• Soils that contain less clay in the subsoil than the Kirley soil

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management consideration: The Mosher soil is poorly suited to cropland.
Management concerns: Kirley—water erosion; Mosher—the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration, and a slow rate of water infiltration
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control erosion.
• Crop rotations that include grasses and legumes help to maintain the content of organic matter and improve tilth.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Kirley—IIe-1; Mosher—IVs-3
Range site: Kirley—Clayey; Mosher—Claypan
Windbreak suitability group: Kirley—3; Mosher—9
Pasture suitability group: Kirley—F; Mosher—C

KmA—Kirley-Ottumwa complex, 0 to 2 percent slopes

Composition

Kirley and similar soils: 40 to 60 percent
Ottumwa and similar soils: 20 to 40 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Terraces
Landform position: Kirley—summits and back slopes; Ottumwa—the lower back slopes and foot slopes
Slope range: Kirley—0 to 2 percent; Ottumwa—0 to 2 percent
Shape of areas: Irregular
Size of areas: 30 to 200 acres

Typical Profile

Kirley

Surface layer:
0 to 5 inches—dark grayish brown clay loam

Subsoil:
5 to 13 inches—dark grayish brown clay
13 to 21 inches—grayish brown, calcareous clay
21 to 34 inches—light brownish gray, calcareous clay loam

Underlying layer:
34 to 60 inches—light brownish gray, calcareous clay loam

Ottumwa

Surface layer:
0 to 6 inches—dark grayish brown silty clay

Subsoil:
6 to 15 inches—dark grayish brown, calcareous clay
15 to 39 inches—grayish brown, calcareous clay
39 to 51 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Underlying layer:
51 to 60 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Kirley—well drained; Ottumwa—well drained
Depth to bedrock: Kirley—very deep; Ottumwa—very deep
Depth to a contrasting layer: Kirley—more than 60 inches; Ottumwa—40 to more than 60 inches over shale bedrock
Depth to a high water table: Kirley—more than 6 feet; Ottumwa—more than 6 feet
Flooding: Kirley—none; Ottumwa—none
Ponding: Kirley—none; Ottumwa—none
Permeability: Kirley—moderately slow; Ottumwa—slow
Available water capacity: Kirley—high; Ottumwa—moderate
Organic matter content: Kirley—moderate; Ottumwa—moderate
Rate of surface runoff: Kirley—low; Ottumwa—medium

Inclusions

Contrasting inclusions:
• The moderately deep Lakoma soils on summits and the upper back slopes
• The moderately well drained Mosher soils, which have a sodium-affected subsoil and are on the lower foot slopes

• The moderately well drained Onita soils, which are dark to a depth of more than 20 inches and are on foot slopes

Similar inclusions:
• Soils that contain less clay in the subsoil than the Kirley soil

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concerns: Kirley—few limitations, except for the need to conserve moisture; Ottumwa—wind erosion, a high content of lime, which adversely affects the availability of plant nutrients, a slow rate of water infiltration, and the limited available water capacity
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control wind erosion, and improve fertility.
• Stripcropping and field windbreaks help to control wind erosion.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Kirley—IIc-2; Ottumwa—IIIs-3
Range site: Kirley—Clayey; Ottumwa—Clayey
Windbreak suitability group: Kirley—3; Ottumwa—4
Pasture suitability group: Kirley—F; Ottumwa—I

KmB—Kirley-Ottumwa complex, 2 to 6 percent slopes

Composition

Kirley and similar soils: 40 to 60 percent
Ottumwa and similar soils: 20 to 40 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Terraces
Landform position: Kirley—summits and back slopes; Ottumwa—the lower back slopes and foot slopes
Slope range: Kirley—2 to 6 percent; Ottumwa—2 to 6 percent
Shape of areas: Irregular
Size of areas: 20 to 200 acres

Typical Profile

Kirley

Surface layer:
0 to 5 inches—dark grayish brown clay loam

Subsoil:
5 to 13 inches—dark grayish brown clay
13 to 21 inches—grayish brown, calcareous clay
21 to 34 inches—light brownish gray, calcareous clay loam

Underlying layer:
34 to 60 inches—light brownish gray, calcareous clay loam

Ottumwa

Surface layer:
0 to 6 inches—dark grayish brown silty clay

Subsoil:
6 to 15 inches—dark grayish brown, calcareous clay
15 to 39 inches—grayish brown, calcareous clay
39 to 51 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Underlying layer:
51 to 60 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Kirley—well drained; Ottumwa—well drained
Depth to bedrock: Kirley—very deep; Ottumwa—very deep
Depth to a contrasting layer: Kirley—more than 60 inches; Ottumwa—40 to more than 60 inches over shale bedrock
Depth to a high water table: Kirley—more than 6 feet; Ottumwa—more than 6 feet
Flooding: Kirley—none; Ottumwa—none
Ponding: Kirley—none; Ottumwa—none
Permeability: Kirley—moderately slow; Ottumwa—slow
Available water capacity: Kirley—high; Ottumwa—moderate
Organic matter content: Kirley—moderate; Ottumwa—moderate
Rate of surface runoff: Kirley—medium; Ottumwa—high

Inclusions

Contrasting inclusions:
• The moderately deep Lakoma soils on summits and the upper back slopes
• The moderately well drained Mosher soils, which have a sodium-affected subsoil and are on the lower foot slopes

Similar inclusions:
• Soils that contain less clay in the subsoil than the Kirley soil
• Soils that contain more clay in the subsoil than the Ottumwa soil

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concerns: Kirley—water erosion; Ottumwa—wind erosion and water erosion, a high content of lime, which adversely affects the availability of plant nutrients, a slow rate of water infiltration, and the limited available water capacity
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, and improve fertility.
• Contour farming, grassed waterways, stripcropping, and field windbreaks help to control erosion.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Kirley—IIe-1; Ottumwa—IIIe-3
Range site: Kirley—Clayey; Ottumwa—Clayey
Windbreak suitability group: Kirley—3; Ottumwa—4
Pasture suitability group: Kirley—F; Ottumwa—I

KmC—Kirley-Ottumwa complex, 6 to 9 percent slopes

Composition

Kirley and similar soils: 40 to 55 percent
Ottumwa and similar soils: 20 to 35 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform: Terraces
Landform position: Kirley—back slopes; Ottumwa—the lower back slopes and foot slopes
Slope range: Kirley—6 to 9 percent; Ottumwa—6 to 9 percent
Shape of areas: Irregular
Size of areas: 10 to 150 acres

Typical Profile

Kirley

Surface layer:
0 to 5 inches—dark grayish brown clay loam

Subsoil:
5 to 13 inches—dark grayish brown clay
13 to 21 inches—grayish brown, calcareous clay
21 to 34 inches—light brownish gray, calcareous clay loam

Underlying layer:
34 to 60 inches—light brownish gray, calcareous clay loam

Ottumwa

Surface layer:
0 to 6 inches—dark grayish brown silty clay

Subsoil:
6 to 15 inches—dark grayish brown, calcareous clay
15 to 39 inches—grayish brown, calcareous clay
39 to 51 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Underlying layer:
51 to 60 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Kirley—well drained; Ottumwa—well drained
Depth to bedrock: Kirley—very deep; Ottumwa—very deep
Depth to a contrasting layer: Kirley—more than 60 inches; Ottumwa—40 to more than 60 inches over shale bedrock
Depth to a high water table: Kirley—more than 6 feet; Ottumwa—more than 6 feet
Flooding: Kirley—none; Ottumwa—none
Ponding: Kirley—none; Ottumwa—none
Permeability: Kirley—moderately slow; Ottumwa—slow
Available water capacity: Kirley—high; Ottumwa—moderate
Organic matter content: Kirley—moderate; Ottumwa—moderate
Rate of surface runoff: Kirley—high; Ottumwa—very high

Inclusions

Contrasting inclusions:
• The moderately deep Lakoma soils, which contain more clay throughout than the Kirley soil and are in positions on the landscape similar to those of the Kirley soil
• The moderately deep Pierre soils, which contain more

clay throughout than the Kirley and Ottumwa soils and are on summits and the upper back slopes
• The moderately well drained Mosher soils, which have a sodium-affected subsoil and are on the lower foot slopes

Similar inclusions:
• Soils that contain less clay in the subsoil than the Kirley soil
• Soils that contain more clay in the subsoil than the Ottumwa soil

Use and Management

Cropland

Main crops: Winter wheat, oats, and alfalfa
Management consideration: The Ottumwa soil is poorly suited to cropland.
Management concerns: Kirley—water erosion; Ottumwa—wind erosion and water erosion, a high content of lime, which adversely affects the availability of plant nutrients, a slow rate of water infiltration, and the limited available water capacity
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, and improve fertility.
• Contour farming, terraces, grassed waterways, stripcropping, and field windbreaks help to control erosion.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Kirley—IIIe-1; Ottumwa—IVe-7
Range site: Kirley—Clayey; Ottumwa—Clayey
Windbreak suitability group: Kirley—3; Ottumwa—4
Pasture suitability group: Kirley—F; Ottumwa—I

KnD—Kirley-Vivian complex, 6 to 15 percent slopes

Composition

Kirley and similar soils: 40 to 60 percent
Vivian and similar soils: 30 to 40 percent
Contrasting inclusions: 10 to 25 percent

Setting

Landform: Terraces
Landform position: Kirley—back slopes; Vivian—summits and shoulder slopes
Slope range: Kirley—6 to 15 percent; Vivian—6 to 15 percent
Shape of areas: Irregular
Size of areas: 20 to 400 acres

Typical Profile

Kirley

Surface layer:
0 to 5 inches—dark grayish brown clay loam

Subsoil:
5 to 13 inches—dark grayish brown clay
13 to 21 inches—grayish brown, calcareous clay
21 to 34 inches—light brownish gray, calcareous clay loam

Underlying layer:
34 to 60 inches—light brownish gray, calcareous clay loam

Vivian

Surface layer:
0 to 3 inches—grayish brown, calcareous gravelly loam

Transitional layer:
3 to 10 inches—light olive brown, calcareous gravelly loam

Underlying layers:
10 to 50 inches—light yellowish brown, calcareous very gravelly loam
50 to 60 inches—light brownish gray, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Kirley—well drained; Vivian—somewhat excessively drained
Depth to bedrock: Kirley—very deep; Vivian—deep
Depth to a contrasting layer: Kirley—more than 60 inches; Vivian—40 to 60 inches over shale bedrock
Depth to a high water table: Kirley—more than 6 feet; Vivian—more than 6 feet
Flooding: Kirley—none; Vivian—none
Ponding: Kirley—none; Vivian—none
Permeability: Kirley—moderately slow; Vivian—moderately rapid in the upper part of the profile and very slow in the lower part
Available water capacity: Kirley—high; Vivian—low
Organic matter content: Kirley—moderate; Vivian—low
Rate of surface runoff: Kirley—very high; Vivian—high
Other properties: The Vivian soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The moderately deep Lakoma soils, which contain more clay throughout than the Kirley and Vivian soils and are in positions on the landscape similar to those of the Kirley soil

• The shallow Okaton soils in positions on the landscape similar to those of the Vivian soil

Similar inclusions:
• Soils that contain less clay in the subsoil than the Kirley soil

Use and Management

Dominant uses: Most of the acreage is used as pasture or range.

Cropland and pasture

Management consideration: The Kirley soil is poorly suited to cropland, and the Vivian soil is unsuited.
Management concerns: Kirley—wind erosion; Vivian—wind erosion and water erosion, the high content of lime, which adversely affects the availability of plant nutrients, the limited available water capacity, and the formation of gullies along some cattle trails
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, and improve fertility.
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.

Interpretive Groups

Land capability classification: Kirley—IVe-1; Vivian—VIe-5
Range site: Kirley—Clayey; Vivian—Thin Upland
Windbreak suitability group: Kirley—3; Vivian—10
Pasture suitability group: Kirley—F; Vivian—NS

Ko—Kolls clay

Composition

Kolls and similar soils: 90 to 99 percent
Contrasting inclusions: 1 to 10 percent

Setting

Landform: Plains
Landform position: Basins
Slope range: 0 to 1 percent
Shape of areas: Circular or oblong
Size of areas: 5 to 100 acres

Typical Profile

Surface layer:
0 to 4 inches—gray clay

Subsoil:
4 to 32 inches—gray, calcareous clay

Underlying layers:
32 to 46 inches—grayish brown, calcareous clay that has masses of gypsum and other salts
46 to 60 inches—gray, calcareous clay that has masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Poorly drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: 0 to 1.5 feet
Flooding: None
Ponding: Frequent, for long periods
Permeability: Very slow
Available water capacity: Moderate
Organic matter content: Moderate
Rate of surface runoff: Negligible

Inclusions

Contrasting inclusions:
• The moderately well drained Capa soils, which have a sodium-affected subsoil and are on foot slopes

Similar inclusions:
• Soils that have a sodium-affected subsoil

Use and Management

Rangeland

Management concerns: Wetness and compaction in areas that are grazed when wet
Management measures:
• Restricting grazing during wet periods, maintaining proper stocking rates, and altering the season of use improve plant vigor and minimize compaction.

Interpretive Groups

Land capability classification: Vw-4
Range site: Closed Depression
Windbreak suitability group: 10
Pasture suitability group: B2

KyA—Kyle clay, 0 to 3 percent slopes

Composition

Kyle and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Plains
Landform position: Foot slopes
Slope range: 0 to 3 percent
Shape of areas: Irregular

Size of areas: 15 to 200 acres

Typical Profile

Surface layer:
0 to 4 inches—grayish brown clay

Subsoil:
4 to 27 inches—grayish brown, calcareous clay
27 to 36 inches—grayish brown, calcareous clay that has nests of gypsum and other salts

Underlying layer:
36 to 60 inches—light olive brown, calcareous clay that has nests of gypsum and other salts

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Low
Organic matter content: Moderately low
Rate of surface runoff: Medium

Inclusions

Contrasting inclusions:
• The well drained Arvada soils, which have a sodium-affected subsoil and are on the lower foot slopes

Similar inclusions:
• Soils that have shale bedrock within a depth of 60 inches

Use and Management

Cropland

Main crops: Winter wheat and alfalfa
Management concerns: Wind erosion, a slow rate of water infiltration, and the limited available water capacity
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control wind erosion, and improve tilth.
• Stripcropping and field windbreaks help to control wind erosion.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIs-3
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: I

KyB—Kyle clay, 3 to 6 percent slopes

Composition

Kyle and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Plains
Landform position: Foot slopes
Slope range: 3 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 400 acres

Typical Profile

Surface layer:
0 to 4 inches—grayish brown clay

Subsoil:
4 to 27 inches—grayish brown, calcareous clay
27 to 36 inches—grayish brown, calcareous clay that has nests of gypsum and other salts

Underlying layer:
36 to 60 inches—light olive brown, calcareous clay that has nests of gypsum and other salts

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Low
Organic matter content: Moderately low
Rate of surface runoff: High

Inclusions

Contrasting inclusions:
• The well drained Arvada soils, which have a sodium-affected subsoil and are on the lower foot slopes

Similar inclusions:
• Soils that have shale bedrock within a depth of 60 inches

Use and Management

Cropland

Main crops: Winter wheat and alfalfa
Management concerns: Wind erosion and water erosion,

a slow rate of water infiltration, and the limited available water capacity
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, and improve tilth.
• Contour farming, grassed waterways, stripcropping, and field windbreaks help to control erosion.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIe-4
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: I

LaB—Lakoma silty clay, 3 to 6 percent slopes

Composition

Lakoma and similar soils: 80 to 95 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Dissected plains
Landform position: Back slopes
Slope range: 3 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 400 acres

Typical Profile

Surface layer:
0 to 5 inches—dark grayish brown, calcareous silty clay

Subsoil:
5 to 21 inches—grayish brown, calcareous silty clay

Underlying layers:
21 to 28 inches—light brownish gray, calcareous silty clay
28 to 60 inches—light gray, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Moderately deep
Depth to contrasting parent material: 20 to 40 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: Low
Organic matter content: Moderately low
Rate of surface runoff: High
Other properties: The soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The very deep, well drained Ottumwa soils, which contain more clay throughout than the Lakoma soil and are on the lower back slopes and on foot slopes
• The very deep, moderately well drained Capa soils, which have a sodium-affected subsoil and are on foot slopes

Similar inclusions:
• Soils that have a darker surface layer
• Soils that have shale bedrock below a depth of 40 inches

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, and alfalfa
Management concerns: Wind erosion and water erosion, a slow rate of water infiltration, the limited available water capacity, and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, maintain fertility, and improve tilth.
• Contour farming, grassed waterways, stripcropping, and field windbreaks help to control erosion.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIe-4
Range site: Thin Upland
Windbreak suitability group: 8
Pasture suitability group: I

LaC—Lakoma silty clay, 6 to 9 percent slopes

Composition

Lakoma and similar soils: 80 to 95 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Dissected plains
Landform position: Back slopes
Slope range: 6 to 9 percent
Shape of areas: Irregular

Size of areas: 10 to 700 acres

Typical Profile

Surface layer:
0 to 5 inches—dark grayish brown, calcareous silty clay

Subsoil:
5 to 21 inches—grayish brown, calcareous silty clay

Underlying layers:
21 to 28 inches—light brownish gray, calcareous silty clay
28 to 60 inches—light gray, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Moderately deep
Depth to contrasting parent material: 20 to 40 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: Low
Organic matter content: Moderately low
Rate of surface runoff: Very high
Other properties: The soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The very deep, well drained Ottumwa soils, which contain more clay throughout than the Lakoma soil and are on the lower back slopes and on foot slopes
• The very deep, moderately well drained Capa soils, which have a sodium-affected subsoil and are on foot slopes
• The shallow Okaton soils on shoulder slopes and the upper back slopes
• The very deep, very poorly drained Herdcamp soils on low flood plains

Similar inclusions:
• Soils that have a darker surface layer
• Soils that have shale bedrock below a depth of 40 inches

Use and Management

Cropland

Main crops: Winter wheat and alfalfa
Management consideration: This soil is poorly suited to cropland.
Management concerns: Wind erosion and water erosion, a slow rate of water infiltration, the limited available water capacity, and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, maintain fertility, and improve tilth.
• Contour farming, terraces, grassed waterways, stripcropping, and field windbreaks help to control erosion.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IVe-4
Range site: Thin Upland
Windbreak suitability group: 8
Pasture suitability group: I

LaD—Lakoma silty clay, 6 to 15 percent slopes

Composition

Lakoma and similar soils: 80 to 95 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Dissected plains
Landform position: Summits and back slopes
Slope range: 6 to 15 percent
Shape of areas: Irregular
Size of areas: 10 to 4,000 acres

Typical Profile

Surface layer:
0 to 5 inches—dark grayish brown, calcareous silty clay

Subsoil:
5 to 21 inches—grayish brown, calcareous silty clay

Underlying layers:
21 to 28 inches—light brownish gray, calcareous silty clay
28 to 60 inches—light gray, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Moderately deep
Depth to contrasting parent material: 20 to 40 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: Low
Organic matter content: Moderately low
Rate of surface runoff: Very high

Other properties: The soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The very deep, well drained Ottumwa soils, which contain more clay throughout than the Lakoma soil and are on the lower back slopes and on foot slopes
• The very deep, moderately well drained Capa soils, which have a sodium-affected subsoil and are on foot slopes
• The shallow Okaton soils on shoulder slopes and the upper back slopes
• The very deep, very poorly drained Herdcamp soils on low flood plains

Similar inclusions:
• Soils that have a darker surface layer
• Soils that have shale bedrock below a depth of 40 inches

Use and Management

Rangeland

Management concerns: Wind erosion and water erosion, a slow rate of water infiltration, the limited available water capacity, the high content of lime, which adversely affects the availability of plant nutrients, and the formation of gullies along some cattle trails
Management measures:
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
• Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: VIe-4
Range site: Thin Upland
Windbreak suitability group: 10
Pasture suitability group: I

LbE—Lakoma-Vivian complex, 9 to 25 percent slopes

Composition

Lakoma and similar soils: 40 to 60 percent
Vivian and similar soils: 15 to 35 percent
Contrasting inclusions: 10 to 25 percent

Setting

Landform: Dissected plains
Landform position: Lakoma—back slopes; Vivian—summits and shoulder slopes
Slope range: Lakoma—9 to 15 percent; Vivian—9 to 25 percent
Shape of areas: Irregular
Size of areas: 25 to 500 acres

Typical Profile

Lakoma

Surface layer:
0 to 5 inches—dark grayish brown, calcareous silty clay

Subsoil:
5 to 21 inches—grayish brown, calcareous silty clay

Underlying layers:
21 to 28 inches—light brownish gray, calcareous silty clay
28 to 60 inches—light gray, calcareous shale bedrock

Vivian

Surface layer:
0 to 3 inches—grayish brown, calcareous gravelly loam

Transitional layer:
3 to 10 inches—light olive brown, calcareous gravelly loam

Underlying layers:
10 to 50 inches—light yellowish brown, calcareous very gravelly loam
50 to 60 inches—light brownish gray, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Lakoma—well drained; Vivian—somewhat excessively drained
Depth to bedrock: Lakoma—moderately deep; Vivian—deep
Depth to a contrasting layer: Lakoma—20 to 40 inches over shale bedrock; Vivian—40 to 60 inches over shale bedrock
Depth to a high water table: Lakoma—more than 6 feet; Vivian—more than 6 feet
Flooding: Lakoma—none; Vivian—none
Ponding: Lakoma—none; Vivian—none
Permeability: Lakoma—slow; Vivian—moderately rapid in the upper part of the profile and very slow in the lower part
Available water capacity: Lakoma—low; Vivian—low
Organic matter content: Lakoma—moderately low; Vivian—low
Rate of surface runoff: Lakoma—very high; Vivian—high
Other properties: Both soils have a high content of lime.

Inclusions

Contrasting inclusions:
• The very deep, well drained Kirley soils on back slopes
• The shallow, well drained Okaton soils on shoulder slopes and the upper back slopes

• The very deep, well drained Ree soils on the back slopes of terraces

Similar inclusions:
• Lakoma soils that have shale bedrock below a depth of 40 inches
• Soils having a darker surface layer than that of the Lakoma soil

Use and Management

Rangeland

Management concerns: Lakoma—wind erosion, water erosion, a slow rate of water infiltration, the available water capacity, the slope, the high content of lime, which limits the availability of plant nutrients, and the formation of gullies along cattle trails; Vivian—wind erosion, water erosion, the available water capacity, the high content of lime, which limits the availability of plant nutrients, and the formation of gullies along cattle trails
Management measures:
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
• Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: Lakoma—VIe-4; Vivian—VIe-5
Range site: Lakoma—Thin Upland; Vivian—Thin Upland
Windbreak suitability group: Lakoma—10; Vivian—10
Pasture suitability group: Lakoma—I; Vivian—NS

Lo—Lohmiller silty clay

Composition

Lohmiller and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Flood plains
Landform position: High flood plains
Slope range: 0 to 2 percent
Shape of areas: Long and narrow
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 4 inches—light brownish gray, calcareous silty clay

Underlying layers:
4 to 16 inches—grayish brown, calcareous silty clay
16 to 60 inches—light brownish gray, calcareous silty clay

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: Rare
Ponding: None
Permeability: Slow
Available water capacity: Moderate
Organic matter content: Moderately low
Rate of surface runoff: Low

Inclusions

Contrasting inclusions:
• The well drained Arvada soils, which have a sodium-affected subsoil and are on foot slopes
• The well drained Haverson soils, which contain less clay throughout than the Lohmiller soil and are in positions on the landscape similar to those of the Lohmiller soil
• The well drained Kyle soils, which contain more clay than the Lohmiller soil and are on the foot slopes of terraces

Similar inclusions:
• Soils that contain more clay throughout

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, and alfalfa
Management concerns: Conserving moisture and controlling wind erosion
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control wind erosion.

Interpretive Groups

Land capability classification: IIc-1
Range site: Loamy Terrace
Windbreak suitability group: 1
Pasture suitability group: F

Lp—Lohmiller silty clay, channeled

Composition

Lohmiller and similar soils: 90 to 99 percent
Contrasting inclusions: 1 to 10 percent

Setting

Landform: Flood plains
Landform position: Low flood plains
Slope range: 0 to 2 percent

Shape of areas: Long and narrow
Size of areas: 20 to 150 acres

Typical Profile

Surface layer:
0 to 4 inches—light brownish gray, calcareous silty clay

Underlying layers:
4 to 16 inches—grayish brown, calcareous silty clay
16 to 60 inches—light brownish gray, calcareous silty clay

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: Occasional, for brief periods
Ponding: None
Permeability: Slow
Available water capacity: Moderate
Organic matter content: Moderately low
Rate of surface runoff: Low
Other properties: The soil is dissected by stream channels.

Inclusions

Contrasting inclusions:
• The well drained Arvada soils, which have a sodium-affected subsoil and are on foot slopes
• The well drained Haverson soils, which contain less clay throughout than the Lohmiller soil and are in positions on the landscape similar to those of the Lohmiller soil
• The well drained Kyle soils, which contain more clay than the Lohmiller soil and are on the foot slopes of terraces
• The well drained Pierre soils, which contain more clay than the Lohmiller soil and are on the lower back slopes on plains

Use and Management

Rangeland

Management concerns: Meandering channels, wind erosion, and wetness
Management measures:
• Restricting grazing during wet periods, maintaining proper stocking rates, and altering the season of use improve plant vigor and minimize compaction.

Interpretive Groups

Land capability classification: VIw-1
Range site: Loamy Overflow
Windbreak suitability group: 1
Pasture suitability group: NS

Lv—Lohmiller-Arvada complex

Composition

Lohmiller and similar soils: 50 to 65 percent
Arvada and similar soils: 30 to 35 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Flood plains and plains
Landform position: Lohmiller—high flood plains; Arvada—foot slopes
Slope range: Lohmiller—0 to 2 percent; Arvada—0 to 3 percent
Shape of areas: Long and narrow
Size of areas: 10 to 300 acres

Typical Profile

Lohmiller

Surface layer:
0 to 4 inches—light brownish gray, calcareous silty clay

Underlying layers:
4 to 16 inches—grayish brown, calcareous silty clay
16 to 60 inches—light brownish gray, calcareous silty clay

Arvada

Surface layer:
0 to 3 inches—light brownish gray silt loam

Subsoil:
3 to 9 inches—grayish brown clay
9 to 14 inches—grayish brown silty clay loam
14 to 43 inches—grayish brown, calcareous silty clay loam that has masses of gypsum and other salts

Underlying layer:
43 to 60 inches—grayish brown, calcareous silty clay loam that has masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Lohmiller—well drained; Arvada—well drained
Depth to bedrock: Lohmiller—very deep; Arvada—very deep
Depth to a contrasting layer: Lohmiller—more than 60 inches; Arvada—more than 60 inches
Depth to a high water table: Lohmiller—more than 6 feet; Arvada—more than 6 feet
Flooding: Lohmiller—rare; Arvada—none
Ponding: Lohmiller—none; Arvada—none
Permeability: Lohmiller—slow; Arvada—very slow
Available water capacity: Lohmiller—moderate; Arvada—low

Organic matter content: Lohmiller—moderately low; Arvada—low
Rate of surface runoff: Lohmiller—low; Arvada—medium
Other properties: The Lohmiller soil is dissected by meandering stream channels in some areas. The Arvada soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• Slickspots, which have salts at or near the surface and are on foot slopes
• The dense Kyle soils on the slightly higher foot slopes

Similar inclusions:
• Soils that contain less clay throughout than the Lohmiller soil

Use and Management

Dominant uses: Most of the acreage is used as pasture or range.

Cropland and pasture

Management consideration: The Arvada soil is unsuited to cropland.
Management concerns: Lohmiller—conserving moisture and controlling wind erosion; Arvada—the limited available water capacity, a slow rate of water infiltration, and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control erosion.
• Crop rotations that include grasses and legumes improve tilth.
• Chiseling or subsoiling increases the rate of water infiltration.
• Proper grazing management helps to maintain plant vigor, conserves moisture, and reduces the hazard of erosion.

Interpretive Groups

Land capability classification: Lohmiller—IIc-1; Arvada—VIs-3
Range site: Lohmiller—Loamy Terrace; Arvada—Thin Claypan
Windbreak suitability group: Lohmiller—1; Arvada—10
Pasture suitability group: Lohmiller—F; Arvada—NS

MaE—Midway silty clay loam, 15 to 40 percent slopes

Composition

Midway and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform: Dissected plains
Landform position: Shoulder slopes and back slopes
Slope range: 15 to 40 percent
Shape of areas: Irregular or long and narrow
Size of areas: 30 to 500 acres

Typical Profile

Surface layer:
0 to 4 inches—light olive brown, calcareous silty clay loam

Transitional layer:
4 to 8 inches—light olive brown, calcareous clay

Underlying layers:
8 to 13 inches—light yellowish brown, calcareous clay
13 to 60 inches—light yellowish brown and light gray, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Shallow
Depth to contrasting parent material: 10 to 20 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: Very low
Organic matter content: Low
Rate of surface runoff: Very high

Inclusions

Contrasting inclusions:
• The moderately deep, well drained Razor soil on the lower back slopes
• The very deep, well drained Nihill soils, which have gravelly underlying layers and are on summits and shoulder slopes

Similar inclusions:
• Soils that have less clay throughout
• Soils that have shale bedrock at a depth of 6 to 10 inches

Use and Management

Rangeland

Management concerns: Wind erosion and water erosion, the slope, the limited depth to bedrock, a high content of lime, which adversely affects the availability of plant nutrients, a slow rate of water infiltration, the limited available water capacity, and the formation of gullies along some cattle trails

Management measures:

• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.

• Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: VIIe-5
Range site: Shallow Clay
Windbreak suitability group: 10
Pasture suitability group: NS

Mo—Mosher silt loam

Composition

Mosher and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform: Terraces
Landform position: Foot slopes
Slope range: 0 to 4 percent
Shape of areas: Irregular
Size of areas: 10 to 160 acres

Typical Profile

Surface layer:
0 to 3 inches—grayish brown silt loam

Subsurface layer:
3 to 6 inches—light brownish gray silt loam

Subsoil:
6 to 18 inches—dark grayish brown clay
18 to 26 inches—grayish brown, calcareous clay loam that has threads of salts

Underlying layer:
26 to 60 inches—pale brown, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: 3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Moderate
Organic matter content: Moderately low
Rate of surface runoff: Medium
Other properties: The soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:

• The moderately well drained Capa soils, which have visible salts within a depth of 16 inches and are on the lower foot slopes

• The well drained Kirley soils, which do not have a sodium-affected subsoil and are on back slopes

• The well drained Ottumwa soils, which do not have a sodium-affected subsoil and are on the lower back slopes on plains

Use and Management

Cropland and pasture

Main crops: Winter wheat, grain sorghum, and alfalfa

Management consideration: This soil is poorly suited to cropland.

Management concerns: The sodium-affected subsoil, which adversely affects plant growth by restricting root penetration, and a slow rate of water infiltration

Management measures:

• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface conserve moisture.

• Crop rotations that include grasses and legumes help to maintain the content of organic matter and improve tilth.

• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IVs-2
Range site: Claypan
Windbreak suitability group: 9
Pasture suitability group: C

Nb—Nimbro silty clay loam

Composition

Nimbro and similar soils: 85 to 99 percent
Contrasting inclusions: 1 to 15 percent

Setting

Landform: Flood plains
Landform position: High flood plains
Slope range: 0 to 2 percent
Shape of areas: Long and narrow or irregular

Size of areas: 10 to 500 acres

Typical Profile

Surface layer:
0 to 8 inches—grayish brown, calcareous silty clay loam

Underlying layers:
8 to 50 inches—light brownish gray and grayish brown, calcareous silty clay loam
50 to 60 inches—light brownish gray silty clay loam that has masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: Rare
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate
Rate of surface runoff: Low

Inclusions

Contrasting inclusions:
• The moderately well drained Wendte soils, which contain more clay than the Nimbro soil and are in positions on the landscape similar to those of the Nimbro soil
• The moderately well drained Hilmoe soils, which contain more clay in the upper part than the Nimbro soil and are in positions on the landscape similar to those of the Nimbro soil

Similar inclusions:
• Soils that contain less clay throughout

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, forage sorghum, and alfalfa
Management concerns: Conserving moisture and controlling wind erosion
Management measures:
• Properly managing crop residue helps to conserve moisture, maintain the content of organic matter and tilth, and control wind erosion

Interpretive Groups

Land capability classification: IIc-1
Range site: Loamy Terrace
Windbreak suitability group: 1
Pasture suitability group: F

Nc—Nimbro silty clay loam, channeled

Composition

Nimbro and similar soils: 80 to 99 percent
Contrasting inclusions: 1 to 20 percent

Setting

Landform: Flood plains
Landform position: Low flood plains (fig. 9)
Slope range: 0 to 2 percent
Shape of areas: Long and narrow
Size of areas: 10 to 100 acres

Typical Profile

Surface layer:
0 to 8 inches—grayish brown, calcareous silty clay loam

Underlying layers:
8 to 50 inches—light brownish gray and grayish brown, calcareous silty clay loam
50 to 60 inches—light brownish gray silty clay loam that has masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: 3.5 to 5.0 feet
Flooding: Frequent, for brief periods
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate
Rate of surface runoff: Low

Inclusions

Contrasting inclusions:
• The well drained and moderately well drained Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of fans and terraces
• The moderately well drained Hilmoe soils, which contain more clay in the upper part than the Nimbro soil and are in positions on the landscape similar to those of the Nimbro soil
• The moderately well drained Wendte soils, which contain more clay than the Nimbro soil and are in positions on the landscape similar to those of the Nimbro soil

Similar inclusions:
• Soils that contain less clay throughout

Figure 9.—An area of Nimbro silty clay loam, channeled, along the Bad River. This soil is frequently flooded.

Use and Management

Rangeland

Management concerns: Meandering channels, wetness, and wind erosion
Management measures:
• Proper grazing management helps to maintain plant vigor and control erosion.

Interpretive Groups

Land capability classification: VIw-1
Range site: Loamy Overflow
Windbreak suitability group: 1
Pasture suitability group: NS

NuA—Nunn loam, 0 to 2 percent slopes

Composition

Nunn and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Terraces
Landform position: Summits and back slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 150 acres

Typical Profile

Surface layer:
0 to 5 inches—grayish brown loam

Subsoil:
5 to 12 inches—grayish brown clay
12 to 26 inches—brown clay
26 to 37 inches—light olive brown, calcareous clay loam

Underlying layer:
37 to 60 inches—light yellowish brown, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained

Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderately low
Rate of surface runoff: Low

Inclusions

Contrasting inclusions:
• The well drained Arvada soils, which have a sodium-affected subsoil and are on foot slopes
• The poorly drained Hoven soils in basins

Similar inclusions:
• Soils that contain less clay in the subsoil

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concerns: Few limitations, except for the need to conserve moisture
Management measures:
• Properly managing crop residue helps to conserve moisture and maintain the content of organic matter and tilth.

Interpretive Groups

Land capability classification: IIc-2
Range site: Silty
Windbreak suitability group: 3
Pasture suitability group: F

NuB—Nunn loam, 2 to 6 percent slopes

Composition

Nunn and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Terraces
Landform position: Back slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 200 acres

Typical Profile

Surface layer:
0 to 5 inches—grayish brown loam

Subsoil:
5 to 12 inches—grayish brown clay
12 to 26 inches—brown clay
26 to 37 inches—light olive brown, calcareous clay loam

Underlying layer:
37 to 60 inches—light yellowish brown, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderately low
Rate of surface runoff: Medium

Inclusions

Contrasting inclusions:
• The well drained Arvada soils, which have a sodium-affected subsoil and are on foot slopes

Similar inclusions:
• Soils that contain less clay in the subsoil

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concern: Water erosion
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control erosion.
• Stripcropping, contour farming, field windbreaks, and grassed waterways help to control erosion.

Interpretive Groups

Land capability classification: IIe-1
Range site: Silty
Windbreak suitability group: 3
Pasture suitability group: F

NuC—Nunn loam, 6 to 9 percent slopes

Composition

Nunn and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform: Terraces
Landform position: Back slopes
Slope range: 6 to 9 percent
Shape of areas: Irregular
Size of areas: 5 to 100 acres

Typical Profile

Surface layer:
0 to 5 inches—grayish brown loam

Subsoil:
5 to 12 inches—grayish brown clay
12 to 26 inches—brown clay
26 to 37 inches—light olive brown, calcareous clay loam

Underlying layer:
37 to 60 inches—light yellowish brown, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderately low
Rate of surface runoff: High

Inclusions

Contrasting inclusions:
• The well drained Nihill soils, which have gravelly underlying layers and are on summits and shoulder slopes
• The moderately deep Pierre soils, which contain more clay throughout than the Nunn soil and are on the lower back slopes

Similar inclusions:
• Soils that contain less clay in the subsoil

Use and Management

Cropland

Main crops: Winter wheat, oats, and alfalfa
Management concern: Water erosion
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control erosion.
• Stripcropping, contour farming, terraces, grassed waterways, and field windbreaks help to control erosion.

Interpretive Groups

Land capability classification: IIIe-1
Range site: Silty
Windbreak suitability group: 3
Pasture suitability group: F

NxD—Nunn-Nihill complex, 6 to 15 percent slopes

Composition

Nunn and similar soils: 40 to 60 percent
Nihill and similar soils: 25 to 40 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Terraces
Landform position: Nunn—back slopes; Nihill—summits and shoulder slopes
Slope range: Nunn—6 to 15 percent; Nihill—9 to 15 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Nunn

Surface layer:
0 to 5 inches—grayish brown loam

Subsoil:
5 to 12 inches—grayish brown clay
12 to 26 inches—brown clay
26 to 37 inches—light olive brown, calcareous clay loam

Underlying layer:
37 to 60 inches—light yellowish brown, calcareous clay loam

Nihill

Surface layer:
0 to 9 inches—grayish brown, calcareous gravelly loam

Underlying layer:
9 to 60 inches—pale yellow, calcareous very gravelly loam

Soil Properties and Qualities

Drainage class: Nunn—well drained; Nihill—well drained
Depth to bedrock: Nunn—very deep; Nihill—very deep
Depth to a contrasting layer: Nunn—more than 60 inches; Nihill—more than 60 inches
Depth to a high water table: Nunn—more than 6 feet; Nihill—more than 6 feet

Flooding: Nunn—none; Nihill—none
Ponding: Nunn—none; Nihill—none
Permeability: Nunn—moderately slow; Nihill—moderate
Available water capacity: Nunn—high; Nihill—low
Organic matter content: Nunn—moderately low; Nihill—low
Rate of surface runoff: Nunn—very high; Nihill—very high
Other properties: The Nihill soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The moderately deep Pierre soils, which contain more clay throughout than the Nunn and Nihill soils and are on the lower back slopes

Similar inclusions:
• Soils that contain less clay in the subsoil than the Nunn soil

Use and Management

Dominant uses: Most of the acreage is used as pasture or range.

Cropland and pasture

Management consideration: The Nunn soil is poorly suited to cropland, and the Nihill soil is unsuited.
Management concerns: Nunn—water erosion; Nihill—wind erosion, water erosion, and the limited available water capacity
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control erosion.
• Crop rotations that include grasses and legumes help to maintain the content of organic matter and improve tilth.
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.

Interpretive Groups

Land capability classification: Nunn—IVe-1; Nihill—VIs-4
Range site: Nunn—Silty; Nihill—Very Shallow
Windbreak suitability group: Nunn—3; Nihill—10
Pasture suitability group: Nunn—F; Nihill—NS

ObE—Okaton-Lakoma silty clays, 15 to 40 percent slopes

Composition

Okaton and similar soils: 45 to 55 percent
Lakoma and similar soils: 40 to 50 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform: Dissected plains
Landform position: Okaton—shoulder slopes and the upper back slopes; Lakoma—back slopes
Slope range: Okaton—15 to 40 percent; Lakoma—15 to 30 percent
Shape of areas: Irregular
Size of areas: 10 to 1,000 acres

Typical Profile

Okaton

Surface layer:
0 to 4 inches—light brownish gray, calcareous silty clay

Transitional layer:
4 to 9 inches—light brownish gray, calcareous silty clay

Underlying layers:
9 to 14 inches—light brownish gray, calcareous silty clay
14 to 60 inches—light brownish gray and pale yellow, calcareous shale bedrock

Lakoma

Surface layer:
0 to 5 inches—dark grayish brown, calcareous silty clay

Subsoil:
5 to 21 inches—grayish brown, calcareous silty clay

Underlying layers:
21 to 28 inches—light brownish gray, calcareous silty clay
28 to 60 inches—light gray, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Okaton—well drained; Lakoma—well drained
Depth to bedrock: Okaton—shallow; Lakoma—moderately deep
Depth to a contrasting layer: Okaton—10 to 20 inches over shale bedrock; Lakoma—20 to 40 inches over shale bedrock
Depth to a high water table: Okaton—more than 6 feet; Lakoma—more than 6 feet
Flooding: Okaton—none; Lakoma—none
Ponding: Okaton—none; Lakoma—none
Permeability: Okaton—slow; Lakoma—slow
Available water capacity: Okaton—very low; Lakoma—low
Organic matter content: Okaton—moderately low; Lakoma—moderately low
Rate of surface runoff: Okaton—very high; Lakoma—very high
Other properties: Both soils have a high content of lime.

Inclusions

Contrasting inclusions:
• The somewhat excessively drained Vivian soils, which have gravelly underlying layers and are on summits and shoulder slopes
• The very deep, well drained and moderately well drained Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of terraces and fans along drainageways
• The moderately well drained, stratified Wendte soils on high flood plains

Similar inclusions:
• Soils that have fewer carbonates throughout
• Soils having a darker surface layer than that of the Lakoma soil
• Soils that are similar to the Lakoma soil but have shale bedrock below a depth of 40 inches
• Okaton soils that have shale bedrock at a depth of 6 to 10 inches

Use and Management

Rangeland

Management concerns: Okaton—the limited available water capacity, a slow rate of water infiltration, wind erosion and water erosion, the slope, and the formation of gullies along some cattle trails; Lakoma—the limited available water capacity, a slow rate of water infiltration, wind erosion and water erosion, the slope, and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
• Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: Okaton—VIIe-8; Lakoma—VIe-4
Range site: Okaton—Shallow; Lakoma—Thin Upland
Windbreak suitability group: Okaton—10; Lakoma—10
Pasture suitability group: Okaton—NS; Lakoma—NS

Oc—Onita silt loam

Composition

Onita and similar soils: 85 to 99 percent
Contrasting inclusions: 1 to 15 percent

Setting

Landform: Terraces
Landform position: Foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular or long and narrow
Size of areas: 10 to 100 acres

Typical Profile

Surface soil:
0 to 12 inches—dark gray silt loam

Subsoil:
12 to 37 inches—dark grayish brown silty clay
37 to 49 inches—grayish brown, calcareous silty clay loam

Underlying layer:
49 to 60 inches—light brownish gray, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: 2.5 to 6.0 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: High
Rate of surface runoff: Medium
Other properties: Runoff flows over the soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The well drained Ree soils, which are not dark below a depth of 20 inches and are on back slopes
• The moderately well drained, sodium-affected Mosher soils on the lower foot slopes

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, corn, oats, and alfalfa
Management concerns: Few limitations, except for the need to conserve moisture
Management measures:
• Properly managing crop residue helps to conserve moisture and maintain the content of organic matter and tilth.

Interpretive Groups

Land capability classification: IIc-3
Range site: Loamy Overflow
Windbreak suitability group: 1
Pasture suitability group: K

OdB—Opal clay, 3 to 6 percent slopes

Composition

Opal and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Dissected plains
Landform position: Back slopes
Slope range: 3 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 250 acres

Typical Profile

Surface layer:
0 to 6 inches—dark gray and dark grayish brown, calcareous clay

Subsoil:
6 to 26 inches—dark grayish brown, calcareous clay
26 to 33 inches—grayish brown, calcareous clay

Underlying layers:
33 to 36 inches—light brownish gray, calcareous clay
36 to 60 inches—light brownish gray shale bedrock

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Moderately deep
Depth to contrasting parent material: 20 to 40 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Low
Organic matter content: Moderate
Rate of surface runoff: High

Inclusions

Contrasting inclusions:
• The very deep, moderately well drained Capa soils, which have a sodium-affected subsoil and are on foot slopes
• The very deep, dense Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of fans and terraces
• The very deep, very poorly drained Herdcamp soils on low flood plains

Similar inclusions:
• Soils that do not have bedded shale bedrock within a depth of 40 inches
• Soils that have a lighter colored surface layer

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concerns: Wind erosion and water erosion, a slow rate of water infiltration, and the limited available water capacity
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, and improve tilth.
• Contour farming, grassed waterways, stripcropping, and field windbreaks help to control erosion.
• Chiseling or subsoiling improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIe-4
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: I

OdC—Opal clay, 6 to 9 percent slopes

Composition

Opal and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Dissected plains
Landform position: Back slopes
Slope range: 6 to 9 percent
Shape of areas: Irregular
Size of areas: 5 to 100 acres

Typical Profile

Surface layer:
0 to 6 inches—dark gray and dark grayish brown, calcareous clay

Subsoil:
6 to 26 inches—dark grayish brown, calcareous clay
26 to 33 inches—grayish brown, calcareous clay

Underlying layers:
33 to 36 inches—light brownish gray, calcareous clay
36 to 60 inches—light brownish gray shale bedrock

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Moderately deep

Depth to contrasting parent material: 20 to 40 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Low
Organic matter content: Moderate
Rate of surface runoff: Very high

Inclusions

Contrasting inclusions:
• The very deep, moderately well drained Capa soils, which have a sodium-affected subsoil and are on foot slopes
• The very deep, dense Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of fans and terraces
• The very deep, very poorly drained Herdcamp soils on low flood plains
• The shallow, well drained Sansarc soils on shoulder slopes

Similar inclusions:
• Soils that do not have bedded shale bedrock within a depth of 40 inches
• Soils that have a lighter colored surface layer

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management consideration: This soil is poorly suited to cropland.
Management concerns: Wind erosion, water erosion, slow water infiltration, the limited available water capacity, and the formation of gullies along some cattle trails
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, and improve tilth.
• Contour farming, terraces, grassed waterways, stripcropping, and field windbreaks help to control erosion.
• Chiseling or subsoiling improves tilth and increases the rate of water infiltration.
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
• Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: IVe-4
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: I

OdD—Opal clay, 6 to 15 percent slopes

Composition

Opal and similar soils: 80 to 95 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Dissected plains
Landform position: Back slopes
Slope range: 6 to 15 percent
Shape of areas: Irregular
Size of areas: 6 to 250 acres

Typical Profile

Surface layer:
0 to 6 inches—dark gray and dark grayish brown, calcareous clay

Subsoil:
6 to 26 inches—dark grayish brown, calcareous clay
26 to 33 inches—grayish brown, calcareous clay

Underlying layers:
33 to 36 inches—light brownish gray, calcareous clay
36 to 60 inches—light brownish gray shale bedrock

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Moderately deep
Depth to contrasting parent material: 20 to 40 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Low
Organic matter content: Moderate
Rate of surface runoff: Very high

Inclusions

Contrasting inclusions:
• The very deep, moderately well drained Capa soils, which have a sodium-affected subsoil and are on foot slopes
• The very deep, dense Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of fans and terraces
• The very deep, very poorly drained Herdcamp soils on low flood plains
• The shallow, well drained Sansarc soils on shoulder slopes

Similar inclusions:
- Soils that do not have bedded shale bedrock within a depth of 40 inches
- Soils that have a lighter colored surface layer

Use and Management

Rangeland

Management concerns: Wind erosion and water erosion, a slow rate of water infiltration, the limited available water capacity, and the formation of gullies along some cattle trails
Management measures:
- Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
- Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: VIe-4
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: I

OeB—Opal-Promise clays, 3 to 6 percent slopes

Composition

Opal and similar soils: 45 to 60 percent
Promise and similar soils: 30 to 40 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Plains
Landform position: Opal—shoulder slopes and the upper back slopes; Promise—the lower back slopes and foot slopes
Slope range: Opal—3 to 6 percent; Promise—3 to 6 percent
Shape of areas: Irregular
Size of areas: 20 to 400 acres

Typical Profile

Opal

Surface layer:
0 to 6 inches—dark gray and dark grayish brown, calcareous clay

Subsoil:
6 to 26 inches—dark grayish brown, calcareous clay
26 to 33 inches—grayish brown, calcareous clay

Underlying layers:
33 to 36 inches—light brownish gray, calcareous clay
36 to 60 inches—light brownish gray shale bedrock

Promise

Surface layer:
0 to 5 inches—dark grayish brown clay

Subsoil:
5 to 29 inches—grayish brown, calcareous clay

Underlying layers:
29 to 40 inches—grayish brown, calcareous clay that has common masses of gypsum and other salts
40 to 60 inches—grayish brown, calcareous clay that has a few masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Opal—well drained; Promise—well drained
Depth to bedrock: Opal—moderately deep; Promise—deep and very deep
Depth to a contrasting layer: Opal—20 to 40 inches over shale bedrock; Promise—40 to more than 60 inches over shale bedrock
Depth to a high water table: Opal—more than 6 feet; Promise—more than 6 feet
Flooding: Opal—none; Promise—none
Ponding: Opal—none; Promise—none
Permeability: Opal—very slow; Promise—very slow
Available water capacity: Opal—low; Promise—moderate
Organic matter content: Opal—moderate; Promise—moderate
Rate of surface runoff: Opal—high; Promise—high

Inclusions

Contrasting inclusions:
- The very deep, moderately well drained Capa soils, which have a sodium-affected subsoil and are on foot slopes
- The poorly drained Kolls soils in basins
- The very deep, dense Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of fans and terraces

Similar inclusions:
- Soils that have a lighter colored surface layer than that of the Opal soil
- Soils that contain less clay than the Promise soil

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concerns: Wind erosion and water erosion, a slow rate of water infiltration, and the limited available water capacity

Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, and improve tilth.
• Contour farming, grassed waterways, stripcropping, and field windbreaks help to control erosion.
• Chiseling or subsoiling improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Opal—IIIe-4; Promise—IIIe-4
Range site: Opal—Clayey; Promise—Clayey
Windbreak suitability group: Opal—4; Promise—4
Pasture suitability group: Opal—I; Promise—I

OeC—Opal-Promise clays, 6 to 9 percent slopes

Composition

Opal and similar soils: 50 to 65 percent
Promise and similar soils: 25 to 35 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Plains
Landform position: Opal—shoulder slopes and the upper back slopes; Promise—the lower back slopes and foot slopes
Slope range: Opal—6 to 9 percent; Promise—6 to 9 percent
Shape of areas: Irregular
Size of areas: 20 to 600 acres

Typical Profile

Opal

Surface layer:
0 to 6 inches—dark gray and dark grayish brown, calcareous clay

Subsoil:
6 to 26 inches—dark grayish brown, calcareous clay
26 to 33 inches—grayish brown, calcareous clay

Underlying layers:
33 to 36 inches—light brownish gray, calcareous clay
36 to 60 inches—light brownish gray shale bedrock

Promise

Surface layer:
0 to 5 inches—dark grayish brown clay

Subsoil:
5 to 29 inches—grayish brown, calcareous clay

Underlying layers:
29 to 40 inches—grayish brown, calcareous clay that has common masses of gypsum and other salts
40 to 60 inches—grayish brown, calcareous clay that has a few masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Opal—well drained; Promise—well drained
Depth to bedrock: Opal—moderately deep; Promise—deep and very deep
Depth to a contrasting layer: Opal—20 to 40 inches over shale bedrock; Promise—40 to more than 60 inches over shale bedrock
Depth to a high water table: Opal—more than 6 feet; Promise—more than 6 feet
Flooding: Opal—none; Promise—none
Ponding: Opal—none; Promise—none
Permeability: Opal—very slow; Promise—very slow
Available water capacity: Opal—low; Promise—moderate
Organic matter content: Opal—moderate; Promise—moderate
Rate of surface runoff: Opal—very high; Promise—very high

Inclusions

Contrasting inclusions:
• The very deep, moderately well drained Capa soils, which have a sodium-affected subsoil and are on foot slopes
• The very deep, dense Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of fans and terraces

Similar inclusions:
• Soils that have a lighter colored surface layer than that of the Opal soil
• Soils that contain less clay than the Promise soil

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management consideration: These soils are poorly suited to cropland.
Management concerns: Wind erosion and water erosion, a slow rate of water infiltration, and the limited available water capacity
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop

residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, and improve tilth.
• Contour farming, terraces, grassed waterways, stripcropping, and field windbreaks help to control erosion.
• Chiseling or subsoiling improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Opal—IVe-4; Promise—IVe-4
Range site: Opal—Clayey; Promise—Clayey
Windbreak suitability group: Opal—4; Promise—4
Pasture suitability group: Opal—I; Promise—I

Of—Orthents, clayey

Composition

Orthents, clayey: 90 to 99 percent
Contrasting inclusions: 1 to 10 percent

Setting

Landform: Terraces
Landform position: Shoulder slopes
Slope range: 0 to 40 percent
Shape of areas: Irregular
Size of areas: 5 to 25 acres

Typical Profile

Surface layer:
0 to 10 inches—gravelly clay loam

Underlying layer:
10 inches—shale bedrock

Soil Properties and Qualities

Drainage class: Poorly drained
Depth to bedrock: Shallow
Depth to contrasting parent material: 5 to 10 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: Very low
Organic matter content: Low
Rate of surface runoff: Very high

Inclusions

Contrasting inclusions:
• The shallow, well drained Samsil soils on shoulder slopes
• The somewhat excessively drained Schamber soils, which have gravelly underlying layers and are on summits and shoulder slopes

Use and Management

Dominant use: Most areas are abandoned gravel pits in which most of the gravel has been removed down to bedded shale.

Wildlife habitat or rangeland

Management concerns: The limited available water capacity, low fertility, and the limited depth to bedrock
Management measures:
• Land shaping is needed because of the slope.
• The mounds of overburden can be used as topsoil dressing.
• Applying fertilizer as needed helps to establish range or pasture plants.

Interpretive Groups

Land capability classification: VIIIs-2
Range site: None
Windbreak suitability group: 10
Pasture suitability group: NS

Og—Orthents, gravelly

Composition

Orthents, gravelly: 90 to 99 percent
Contrasting inclusions: 1 to 10 percent

Setting

Landform: Terraces
Landform position: Shoulder slopes
Slope range: 0 to 60 percent
Shape of areas: Irregular
Size of areas: 5 to 30 acres

Typical Profile

Surface layer:
0 to 4 inches—gravelly loam

Underlying layer:
4 inches—gravelly or very gravelly sand

Soil Properties and Qualities

Drainage class: Excessively drained
Depth to bedrock: Very deep
Depth to contrasting parent material: 0 to 10 inches over gravelly material
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Rapid

Available water capacity: Very low
Organic matter content: Low
Rate of surface runoff: Medium

Inclusions

Contrasting inclusions:
• The shallow, well drained Samsil soils on shoulder slopes
• The somewhat excessively drained Schamber soils, which have gravelly underlying layers and are on summits and shoulder slopes

Use and Management

Dominant uses: Most areas are gravel pits used as a source of sand and gravel for construction purposes. Some provide limited wildlife habitat. Abandoned gravel pits can be restored to range or tame pasture if reclamation measures are applied.

Wildlife habitat or rangeland

Management concerns: The limited available water capacity and low fertility
Management measures:
• Land shaping is needed because of the slope.
• The mounds of overburden can be used as topsoil dressing.
• Applying fertilizer as needed helps to establish range or pasture plants.

Interpretive Groups

Land capability classification: VIIIs-2
Range site: None
Windbreak suitability group: 10
Pasture suitability group: NS

OtA—Ottumwa silty clay, 0 to 3 percent slopes

Composition

Ottumwa and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Plains
Landform position: The lower back slopes and foot slopes
Slope range: 0 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 500 acres

Typical Profile

Surface layer:
0 to 6 inches—dark grayish brown silty clay

Subsoil:
6 to 15 inches—dark grayish brown, calcareous clay
15 to 39 inches—grayish brown, calcareous clay
39 to 51 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Underlying layer:
51 to 60 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: 40 to more than 60 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: Moderate
Organic matter content: Moderate
Rate of surface runoff: Medium

Inclusions

Contrasting inclusions:
• The poorly drained Kolls soils in basins
• The moderately well drained Capa soils, which have a sodium-affected subsoil and are on the lower foot slopes

Similar inclusions:
• Soils that have a lighter colored surface layer
• Soils that contain more clay throughout
• Soils that are dark to a depth of more than 20 inches
• Soils that have shale bedrock within a depth of 40 inches

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, corn, oats, and alfalfa
Management concerns: Wind erosion and a slow rate of water infiltration
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control wind erosion, and improve tilth.
• Stripcropping and field windbreaks help to control wind erosion.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIs-3
Range site: Clayey

Windbreak suitability group: 4
Pasture suitability group: I

OtB—Ottumwa silty clay, 3 to 6 percent slopes

Composition

Ottumwa and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Plains
Landform position: The lower back slopes and foot slopes
Slope range: 3 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 400 acres

Typical Profile

Surface layer:
0 to 6 inches—dark grayish brown silty clay

Subsoil:
6 to 15 inches—dark grayish brown, calcareous clay
15 to 39 inches—grayish brown, calcareous clay
39 to 51 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Underlying layer:
51 to 60 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: 40 to more than 60 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: Moderate
Organic matter content: Moderate
Rate of surface runoff: High

Inclusions

Contrasting inclusions:
• The poorly drained Kolls soils in basins
• The moderately well drained Capa soils, which have a sodium-affected subsoil and are on the lower foot slopes
• The moderately deep Lakoma soils on the upper summits and back slopes

Similar inclusions:
• Soils that have a lighter colored surface layer
• Soils that contain more clay throughout
• Soils that are dark to a depth of more than 20 inches
• Soils that have shale bedrock within a depth of 40 inches

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, corn, oats, and alfalfa
Management concerns: Wind erosion, water erosion, and a slow rate of water infiltration
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control wind erosion, and improve tilth.
• Contour farming, grassed waterways, stripcropping, and field windbreaks help to control erosion.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIe-3
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: I

OvA—Ottumwa-Capa complex, 0 to 3 percent slopes

Composition

Ottumwa and similar soils: 50 to 60 percent
Capa and similar soils: 20 to 40 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform: Plains
Landform position: Ottumwa—foot slopes; Capa—the lower foot slopes
Slope range: Ottumwa—0 to 3 percent; Capa—0 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 300 acres

Typical Profile

Ottumwa

Surface layer:
0 to 6 inches—dark grayish brown silty clay

Subsoil:
6 to 15 inches—dark grayish brown, calcareous clay
15 to 39 inches—grayish brown, calcareous clay

39 to 51 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Underlying layer:
51 to 60 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Capa

Surface layer:
0 to 2 inches—gray silt loam

Subsoil:
2 to 7 inches—grayish brown clay
7 to 14 inches—grayish brown, calcareous clay
14 to 20 inches—grayish brown, calcareous clay that has masses of gypsum and other salts
20 to 28 inches—grayish brown, calcareous silty clay that has masses of gypsum and other salts

Underlying layers:
28 to 52 inches—grayish brown, calcareous silty clay that has masses of gypsum and other salts
52 to 60 inches—grayish brown, calcareous silty clay

Soil Properties and Qualities

Drainage class: Ottumwa—well drained; Capa—moderately well drained
Depth to bedrock: Ottumwa—very deep; Capa—very deep
Depth to a contrasting layer: Ottumwa—40 to more than 60 inches over shale bedrock; Capa—more than 60 inches
Depth to a high water table: Ottumwa—more than 6.0 feet; Capa—3.5 to 5.0 feet
Flooding: Ottumwa—none; Capa—none
Ponding: Ottumwa—none; Capa—none
Permeability: Ottumwa—slow; Capa—very slow
Available water capacity: Ottumwa—moderate; Capa—low
Organic matter content: Ottumwa—moderate; Capa—moderately low
Rate of surface runoff: Ottumwa—medium; Capa—medium
Other properties: The Capa soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
- The moderately well drained, stratified Wendte soils on high flood plains
- The moderately deep Lakoma soils on summits and back slopes
- The poorly drained Kolls soils in basins

Similar inclusions:
- Soils that contain more clay throughout
- Soils that are dark to a depth of more than 20 inches

Use and Management

Dominant uses: Most of the acreage is used as pasture or range.

Cropland and pasture

Main crops: Winter wheat and alfalfa
Management consideration: The Capa soil is unsuited to cropland.
Management concerns: Ottumwa—wind erosion and a slow rate of water infiltration; Capa—the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration, the limited available water capacity, and a slow rate of water infiltration
Management measures:
- Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control wind erosion, and improve tilth.
- Stripcropping and field windbreaks help to control wind erosion.
- Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Ottumwa—IIIs-3; Capa—VIs-1
Range site: Ottumwa—Clayey; Capa—Thin Claypan
Windbreak suitability group: Ottumwa—4; Capa—10
Pasture suitability group: Ottumwa—I; Capa—NS

OwB—Ottumwa-Lakoma silty clays, 3 to 6 percent slopes

Composition

Ottumwa and similar soils: 60 to 70 percent
Lakoma and similar soils: 20 to 35 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform: Plains
Landform position: Ottumwa—back slopes; Lakoma—the upper back slopes and shoulder slopes
Slope range: Ottumwa—3 to 6 percent; Lakoma—3 to 6 percent
Shape of areas: Irregular
Size of areas: 40 to 2,000 acres

Typical Profile

Ottumwa

Surface layer:
0 to 6 inches—dark grayish brown silty clay

Subsoil:
6 to 15 inches—dark grayish brown, calcareous clay
15 to 39 inches—grayish brown, calcareous clay
39 to 51 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Underlying layer:
51 to 60 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Lakoma

Surface layer:
0 to 5 inches—dark grayish brown, calcareous silty clay

Subsoil:
5 to 21 inches—grayish brown, calcareous silty clay

Underlying layers:
21 to 28 inches—light brownish gray, calcareous silty clay
28 to 60 inches—light gray, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Ottumwa—well drained; Lakoma—well drained
Depth to bedrock: Ottumwa—very deep; Lakoma—moderately deep
Depth to a contrasting layer: Ottumwa—40 to more than 60 inches over shale bedrock; Lakoma—20 to 40 inches over shale bedrock
Depth to a high water table: Ottumwa—more than 6 feet; Lakoma—more than 6 feet
Flooding: Ottumwa—none; Lakoma—none
Ponding: Ottumwa—none; Lakoma—none
Permeability: Ottumwa—slow; Lakoma—slow
Available water capacity: Ottumwa—moderate; Lakoma—low
Organic matter content: Ottumwa—moderate; Lakoma—moderately low
Rate of surface runoff: Ottumwa—high; Lakoma—high
Other properties: The Lakoma soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The very deep, moderately well drained Capa soils, which have a sodium-affected subsoil and are on foot slopes
• The very deep, dense Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of fans and terraces
• The poorly drained Kolls soils in basins

Similar inclusions:
• Ottumwa soils that have with shale bedrock within a depth of 40 inches
• Soils that have a lighter colored surface layer than that of the Ottumwa soil
• Soils that contain more clay than the Ottumwa soil

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concerns: Ottumwa—wind erosion, water erosion, and a slow rate of water infiltration; Lakoma—wind erosion, water erosion, a slow rate of water infiltration, the limited available water capacity, and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, and improve fertility.
• Contour farming, grassed waterways, stripcropping, and field windbreaks help to control erosion.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Ottumwa—IIIe-3; Lakoma—IIIe-4
Range site: Ottumwa—Clayey; Lakoma—Thin Upland
Windbreak suitability group: Ottumwa—4; Lakoma—8
Pasture suitability group: Ottumwa—I; Lakoma—I

OwC—Ottumwa-Lakoma silty clays, 6 to 9 percent slopes

Composition

Ottumwa and similar soils: 50 to 55 percent
Lakoma and similar soils: 30 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Plains
Landform position: Ottumwa—back slopes; Lakoma—shoulder slopes and the upper back slopes
Slope range: Ottumwa—6 to 9 percent; Lakoma—6 to 9 percent
Shape of areas: Irregular
Size of areas: 30 to 500 acres

Typical Profile

Ottumwa

Surface layer:
0 to 6 inches—dark grayish brown silty clay

Subsoil:
6 to 15 inches—dark grayish brown, calcareous clay
15 to 39 inches—grayish brown, calcareous clay
39 to 51 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Underlying layer:
51 to 60 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Lakoma

Surface layer:
0 to 5 inches—dark grayish brown, calcareous silty clay

Subsoil:
5 to 21 inches—grayish brown, calcareous silty clay

Underlying layers:
21 to 28 inches—light brownish gray, calcareous silty clay
28 to 60 inches—light gray, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Ottumwa—well drained; Lakoma—well drained
Depth to bedrock: Ottumwa—very deep; Lakoma—moderately deep
Depth to a contrasting layer: Ottumwa—40 to more than 60 inches over shale bedrock; Lakoma—20 to 40 inches over shale bedrock
Depth to a high water table: Ottumwa—more than 6 feet; Lakoma—more than 6 feet
Flooding: Ottumwa—none; Lakoma—none
Ponding: Ottumwa—none; Lakoma—none
Permeability: Ottumwa—slow; Lakoma—slow
Available water capacity: Ottumwa—moderate; Lakoma—low
Organic matter content: Ottumwa—moderate; Lakoma—moderately low
Rate of surface runoff: Ottumwa—very high; Lakoma—very high
Other properties: The Lakoma soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The very deep, moderately well drained Capa soils, which have a sodium-affected subsoil and are on foot slopes
• The very deep, dense Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of fans and terraces

Similar inclusions:
• Ottumwa soils that have with shale bedrock within a depth of 40 inches
• Soils that have a lighter colored surface layer than that of the Ottumwa soil
• Soils that contain more clay than the Ottumwa soil

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management consideration: These soils are poorly suited to cropland.
Management concerns: Ottumwa—wind erosion, water erosion, and a slow rate of water infiltration; Lakoma—wind erosion, water erosion, a slow rate of water infiltration, the limited available water capacity, and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, and improve fertility.
• Contour farming, terraces, grassed waterways, stripcropping, and field windbreaks help to control erosion.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Ottumwa—IVe-7; Lakoma—IVe-4
Range site: Ottumwa—Clayey; Lakoma—Thin Upland
Windbreak suitability group: Ottumwa—4; Lakoma—8
Pasture suitability group: Ottumwa—I; Lakoma—I

OxC—Ottumwa-Razor silty clays, 6 to 9 percent slopes

Composition

Ottumwa and similar soils: 50 to 60 percent
Razor and similar soils: 25 to 35 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Plains
Landform position: Ottumwa—back slopes; Razor—shoulder slopes and the upper back slopes
Slope range: Ottumwa—6 to 9 percent; Razor—6 to 9 percent

Shape of areas: Irregular
Size of areas: 20 to 450 acres

Typical Profile

Ottumwa

Surface layer:
0 to 6 inches—dark grayish brown silty clay

Subsoil:
6 to 15 inches—dark grayish brown, calcareous clay
15 to 39 inches—grayish brown, calcareous clay
39 to 51 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Underlying layer:
51 to 60 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Razor

Surface layer:
0 to 4 inches—grayish brown silty clay

Subsoil:
4 to 14 inches—grayish brown silty clay
14 to 29 inches—light olive brown and light brownish gray, calcareous silty clay

Underlying layer:
29 to 60 inches—light yellowish brown, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Ottumwa—well drained; Razor—well drained
Depth to bedrock: Ottumwa—very deep; Razor—moderately deep
Depth to a contrasting layer: Ottumwa—40 to more than 60 inches over shale bedrock; Razor—20 to 40 inches over shale bedrock
Depth to a high water table: Ottumwa—more than 6 feet; Razor—more than 6 feet
Flooding: Ottumwa—none; Razor—none
Ponding: Ottumwa—none; Razor—none
Permeability: Ottumwa—slow; Razor—slow
Available water capacity: Ottumwa—moderate; Razor—low
Organic matter content: Ottumwa—moderate; Razor—low
Rate of surface runoff: Ottumwa—very high; Razor—high

Inclusions

Contrasting inclusions:
- The well drained Arvada soils, which have a sodium-affected subsoil and are on foot slopes
- The shallow, well drained Midway soils on shoulder slopes

Similar inclusions:
- Soils that contain more silt and less clay than the Ottumwa soil
- Soils that have a lighter colored surface layer than that of the Ottumwa soil

Use and Management

Cropland and pasture

Main crops: Winter wheat, oats, and alfalfa
Management consideration: These soils are poorly suited to cropland.
Management concerns: Ottumwa—wind erosion, water erosion, and a slow rate of water infiltration; Razor—wind erosion, water erosion, a slow rate of water infiltration, and the limited available water capacity
Management measures:
- Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, and improve tilth.
- Stripcropping, contour farming, terraces, grassed waterways, and field windbreaks reduce the hazard of erosion.
- Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Ottumwa—IVe-7; Razor—IVe-4
Range site: Ottumwa—Clayey; Razor—Clayey
Windbreak suitability group: Ottumwa—4; Razor—4
Pasture suitability group: Ottumwa—I; Razor—I

OyC—Ottumwa-Razor-Savo complex, 6 to 15 percent slopes

Composition

Ottumwa and similar soils: 30 to 40 percent
Razor and similar soils: 20 to 35 percent
Savo and similar soils: 15 to 25 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Plains
Landform position: Ottumwa—back slopes; Razor—summits and shoulder slopes; Savo—foot slopes
Slope range: Ottumwa—6 to 9 percent; Razor—6 to 15 percent; Savo—6 to 9 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

Ottumwa

Surface layer:
0 to 6 inches—dark grayish brown silty clay

Subsoil:
6 to 15 inches—dark grayish brown, calcareous clay
15 to 39 inches—grayish brown, calcareous clay
39 to 51 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Underlying layer:
51 to 60 inches—light brownish gray, calcareous silty clay that has masses of gypsum and other salts

Razor

Surface layer:
0 to 4 inches—grayish brown silty clay

Subsoil:
4 to 14 inches—grayish brown silty clay
14 to 29 inches—light olive brown and light brownish gray, calcareous silty clay

Underlying layer:
29 to 60 inches—light yellowish brown, calcareous shale bedrock

Savo

Surface layer:
0 to 6 inches—grayish brown silt loam

Subsoil:
6 to 13 inches—grayish brown silty clay loam
13 to 20 inches—light olive brown silty clay loam
20 to 35 inches—grayish brown, calcareous silty clay loam
35 to 60 inches—light yellowish brown, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Ottumwa—well drained; Razor—well drained; Savo—well drained
Depth to bedrock: Ottumwa—very deep; Razor—moderately deep; Savo—very deep
Depth to contrasting parent material: Ottumwa—40 to more than 60 inches over shale bedrock; Razor—20 to 40 inches over shale bedrock; Savo—more than 60 inches
Depth to a high water table: Ottumwa—more than 6 feet; Razor—more than 6 feet; Savo—more than 6 feet
Flooding: Ottumwa—none; Razor—none; Savo—none
Ponding: Ottumwa—none; Razor—none; Savo—none
Permeability: Ottumwa—slow; Razor—slow; Savo—moderately slow
Available water capacity: Ottumwa—moderate; Razor—low; Savo—high
Organic matter content: Ottumwa—moderate; Razor—low; Savo—moderate
Rate of surface runoff: Ottumwa—very high; Razor—very high; Savo—high

Inclusions

Contrasting inclusions:
• The shallow, well drained Midway soils on shoulder slopes
• The stratified Lohmiller soils on high flood plains

Use and Management

Dominant uses: Most of the acreage is used as pasture or range.

Cropland and pasture

Main crops: Winter wheat, oats, and alfalfa
Management consideration: These soils are poorly suited to cropland.
Management concerns: Ottumwa—wind erosion, water erosion, and a slow rate of water infiltration; Razor—wind erosion, water erosion, a slow rate of water infiltration, and the limited available water capacity; Savo—water erosion
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, and improve tilth.
• Stripcropping, contour farming, terraces, grassed waterways, and field windbreaks help to control erosion.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Ottumwa—IVe-7; Razor—VIe-4; Savo—IIIe-1
Range site: Ottumwa—Clayey; Razor—Clayey; Savo—Silty
Windbreak suitability group: Ottumwa—4; Razor—4; Savo—3
Pasture suitability group: Ottumwa—I; Razor—I; Savo—F

PeC—Pierre clay, 6 to 9 percent slopes

Composition

Pierre and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Dissected plains

Landform position: Back slopes
Slope range: 6 to 9 percent
Shape of areas: Irregular
Size of areas: 20 to 400 acres

Typical Profile

Surface layer:
0 to 2 inches—grayish brown, calcareous clay

Transitional layer:
2 to 7 inches—light brownish gray, calcareous clay

Subsoil:
7 to 20 inches—light brownish gray, calcareous clay
20 to 27 inches—light brownish gray, calcareous clay that has masses of gypsum

Underlying layers:
27 to 40 inches—light brownish gray, calcareous shale bedrock that has masses of gypsum
40 to 60 inches—light olive gray shale bedrock

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Moderately deep
Depth to contrasting parent material: 20 to 40 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Low
Organic matter content: Low
Rate of surface runoff: High

Inclusions

Contrasting inclusions:
• The shallow Samsil soils on shoulder slopes and the upper back slopes
• The stratified Lohmiller soils on high flood plains

Similar inclusions:
• Soils that do not have bedded shale bedrock within a depth of 40 inches

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concerns: Wind erosion and water erosion, a slow rate of water infiltration, and the limited available water capacity
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, and improve tilth.
• Contour farming, grassed waterways, stripcropping, and field windbreaks help to control erosion.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IVe-4
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: I

PeD—Pierre clay, 6 to 15 percent slopes

Composition

Pierre and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Dissected plains
Landform position: Back slopes
Slope range: 6 to 15 percent
Shape of areas: Irregular
Size of areas: 20 to 1,000 acres

Typical Profile

Surface layer:
0 to 2 inches—grayish brown, calcareous clay

Transitional layer:
2 to 7 inches—light brownish gray, calcareous clay

Subsoil:
7 to 20 inches—light brownish gray, calcareous clay
20 to 27 inches—light brownish gray, calcareous clay that has masses of gypsum

Underlying layers:
27 to 40 inches—light brownish gray, calcareous shale bedrock that has masses of gypsum
40 to 60 inches—light olive gray shale bedrock

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Moderately deep
Depth to contrasting parent material: 20 to 40 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Low
Organic matter content: Low

Rate of surface runoff: Very high

Inclusions

Contrasting inclusions:
• The shallow Samsil soils on shoulder slopes and the upper back slopes
• The stratified Lohmiller soils on high flood plains

Similar inclusions:
• Soils that do not have bedded shale bedrock within a depth of 40 inches
• Soils that contain less clay throughout

Use and Management

Rangeland

Management concerns: Wind erosion and water erosion, a slow rate of water infiltration, the limited available water capacity, and the formation of gullies along some cattle trails
Management measures:
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
• Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: VIe-4
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: I

PkE—Pierre-Samsil clays, 15 to 25 percent slopes

Composition

Pierre and similar soils: 45 to 55 percent
Samsil and similar soils: 35 to 45 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Dissected plains
Landform position: Pierre—back slopes; Samsil—shoulder slopes and the upper back slopes
Slope range: Pierre—15 to 25 percent; Samsil—15 to 25 percent
Shape of areas: Irregular
Size of areas: 20 to 2,000 acres

Typical Profile

Pierre

Surface layer:
0 to 2 inches—grayish brown, calcareous clay

Transitional layer:
2 to 7 inches—light brownish gray, calcareous clay

Subsoil:
7 to 20 inches—light brownish gray, calcareous clay
20 to 27 inches—light brownish gray, calcareous clay that has masses of gypsum

Underlying layers:
27 to 40 inches—light brownish gray, calcareous shale bedrock that has masses of gypsum
40 to 60 inches—light olive gray shale bedrock

Samsil

Surface layer:
0 to 4 inches—grayish brown, calcareous clay

Transitional layer:
4 to 8 inches—grayish brown, calcareous clay

Underlying layers:
8 to 14 inches—light brownish gray, calcareous clay
14 to 60 inches—light brownish gray, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Pierre—well drained; Samsil—well drained
Depth to bedrock: Pierre—moderately deep; Samsil—shallow
Depth to a contrasting layer: Pierre—20 to 40 inches over shale bedrock; Samsil—10 to 20 inches over shale bedrock
Depth to a high water table: Pierre—more than 6 feet; Samsil—more than 6 feet
Flooding: Pierre—none; Samsil—none
Ponding: Pierre—none; Samsil—none
Permeability: Pierre—very slow; Samsil—slow
Available water capacity: Pierre—low; Samsil—low
Organic matter content: Pierre—low; Samsil—low
Rate of surface runoff: Pierre—very high; Samsil—very high

Inclusions

Contrasting inclusions:
• The excessively drained Schamber soils, which have gravelly underlying layers and are on summits and shoulder slopes
• Rock outcrop, which consists of exposed shale bedrock on steep back slopes along drainageways
• The well drained Arvada soils, which have a sodium-affected subsoil and are on foot slopes

Similar inclusions:
• Soils that do not have shale bedrock within a depth of 40 inches
• Soils that have a surface layer that is darker colored

than the surface layer in the Pierre soil
• Soils that contain more carbonates throughout

Use and Management

Rangeland

Management concerns: Wind erosion and water erosion, a slow rate of water infiltration, the limited available water capacity, the slope, a high content of lime, which adversely affects the availability of plant nutrients, and the formation of gullies along some cattle trails
Management measures:
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
• Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: Pierre—VIe-4; Samsil—VIe-12
Range site: Pierre—Clayey; Samsil—Shallow Clay
Windbreak suitability group: Pierre—10; Samsil—10
Pasture suitability group: Pierre—NS; Samsil—NS

PrA—Promise clay, 0 to 3 percent slopes

Composition

Promise and similar soils: 85 to 99 percent
Contrasting inclusions: 1 to 15 percent

Setting

Landform: Plains
Landform position: The lower back slopes and foot slopes
Slope range: 0 to 3 percent
Shape of areas: Irregular
Size of areas: 5 to 400 acres

Typical Profile

Surface layer:
0 to 5 inches—dark grayish brown clay

Subsoil:
5 to 29 inches—grayish brown, calcareous clay

Underlying layers:
29 to 40 inches—grayish brown, calcareous clay that has common masses of gypsum and other salts
40 to 60 inches—grayish brown, calcareous clay that has a few masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Deep and very deep
Depth to contrasting parent material: 40 to more than 60 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Moderate
Organic matter content: Moderate
Rate of surface runoff: Medium

Inclusions

Contrasting inclusions:
• The very deep, moderately well drained Capa soils, which have a sodium-affected subsoil and are on foot slopes
• The very deep, dense Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of fans and terraces
• The poorly drained Kolls soils in basins

Similar inclusions:
• Soils that have bedded shale bedrock within a depth of 40 inches
• Soils that contain less clay throughout
• Soils that are dark to a depth of more than 20 inches

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concerns: Wind erosion and water erosion, a slow rate of water infiltration, and the limited available water capacity
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, and improve tilth.
• Stripcropping and field windbreaks help to control wind erosion.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIs-3
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: I

PrB—Promise clay, 3 to 6 percent slopes

Composition

Promise and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform: Plains
Landform position: The lower back slopes and foot slopes
Slope range: 3 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 500 acres

Typical Profile

Surface layer:
0 to 5 inches—dark grayish brown clay

Subsoil:
5 to 29 inches—grayish brown, calcareous clay

Underlying layers:
29 to 40 inches—grayish brown, calcareous clay that has common masses of gypsum and other salts
40 to 60 inches—grayish brown, calcareous clay that has a few masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Deep and very deep
Depth to contrasting parent material: 40 to more than 60 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Moderate
Organic matter content: Moderate
Rate of surface runoff: High

Inclusions

Contrasting inclusions:
• The very deep, moderately well drained Capa soils, which have a sodium-affected subsoil and are on foot slopes
• The very deep, dense Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of fans and terraces
• The poorly drained Kolls soils in basins

Similar inclusions:
• Soils that have bedded shale bedrock within a depth of 40 inches
• Soils that contain less clay throughout

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concerns: Wind erosion and water erosion, a slow rate of water infiltration, and the limited available water capacity
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, and improve tilth.
• Contour farming, grassed waterways, stripcropping, and field windbreaks help to control erosion.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIe-4
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: I

RaB—Razor silty clay, 2 to 6 percent slopes

Composition

Razor and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Dissected plains
Landform position: Back slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 50 acres

Typical Profile

Surface layer:
0 to 4 inches—grayish brown silty clay

Subsoil:
4 to 14 inches—grayish brown silty clay
14 to 29 inches—light olive brown and light brownish gray, calcareous silty clay

Underlying layer:
29 to 60 inches—light yellowish brown, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Moderately deep
Depth to contrasting parent material: 20 to 40 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: Low

Organic matter content: Low
Rate of surface runoff: High

Inclusions

Contrasting inclusions:
• The shallow Midway soils on shoulder slopes and the upper back slopes
• The very deep Ottumwa soils, which have a darker surface layer than that of the Razor soil and are on the lower back slopes and on foot slopes

Use and Management

Cropland

Main crops: Winter wheat and alfalfa
Management consideration: This soil is poorly suited to cropland.
Management concerns: Wind erosion and water erosion, a slow rate of water infiltration, and the limited available water capacity
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, and improve tilth.
• Contour farming, grassed waterways, stripcropping, and field windbreaks reduce the hazard of erosion.
• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IVe-4
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: I

RaC—Razor silty clay, 6 to 9 percent slopes

Composition

Razor and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Dissected plains
Landform position: Back slopes
Slope range: 6 to 9 percent
Shape of areas: Irregular
Size of areas: 15 to 25 acres

Typical Profile

Surface layer:
0 to 4 inches—grayish brown silty clay

Subsoil:
4 to 14 inches—grayish brown silty clay
14 to 29 inches—light olive brown and light brownish gray, calcareous silty clay

Underlying layer:
29 to 60 inches—light yellowish brown, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Moderately deep
Depth to contrasting parent material: 20 to 40 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: Low
Organic matter content: Low
Rate of surface runoff: High

Inclusions

Contrasting inclusions:
• The shallow Midway soils on shoulder slopes on the steeper ridges
• The very deep Ottumwa soils, which have a darker surface layer than that of the Razor soil and are on the lower back slopes and on foot slopes
• The very deep Savo soils, which do not have a sodium-affected subsoil and are in areas on back slopes

Similar inclusions:
• Soils that have a darker and thicker surface layer

Use and Management

Cropland

Main crop: Winter wheat
Management consideration: This soil is poorly suited to cropland.
Management concerns: Wind erosion and water erosion, a slow rate of water infiltration, and the limited available water capacity
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, reduce the hazard of erosion, and improve tilth.
• Contour farming, terraces, grassed waterways, stripcropping, and field windbreaks reduce the hazard of erosion.

• Chiseling or subsoiling during dry periods improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IVe-14
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: I

RbD—Razor-Midway complex, 6 to 15 percent slopes

Composition

Razor and similar soils: 45 to 60 percent
Midway and similar soils: 25 to 35 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Dissected plains
Landform position: Razor—back slopes; Midway—summits and shoulder slopes
Slope range: Razor—6 to 15 percent; Midway—6 to 15 percent
Shape of areas: Irregular
Size of areas: 30 to 400 acres

Typical Profile

Razor

Surface layer:
0 to 4 inches—grayish brown silty clay

Subsoil:
4 to 14 inches—grayish brown silty clay
14 to 29 inches—light olive brown and light brownish gray, calcareous silty clay

Underlying layer:
29 to 60 inches—light yellowish brown, calcareous shale bedrock

Midway

Surface layer:
0 to 4 inches—light olive brown, calcareous silty clay loam

Transitional layer:
4 to 8 inches—light olive brown, calcareous clay

Underlying layers:
8 to 13 inches—light yellowish brown, calcareous clay
13 to 60 inches—light yellowish brown and light gray, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Razor—well drained; Midway—well drained
Depth to bedrock: Razor—moderately deep; Midway—shallow
Depth to a contrasting layer: Razor—20 to 40 inches over shale bedrock; Midway—10 to 20 inches over shale bedrock
Depth to a high water table: Razor—more than 6 feet; Midway—more than 6 feet
Flooding: Razor—none; Midway—none
Ponding: Razor—none; Midway—none
Permeability: Razor—slow; Midway—slow
Available water capacity: Razor—low; Midway—very low
Organic matter content: Razor—low; Midway—low
Rate of surface runoff: Razor—very high; Midway—very high

Inclusions

Contrasting inclusions:
• The very deep Savo soils, which have a darker surface layer than that of the Razor and Midway soils and are on foot slopes
• The very deep Ottumwa soils, which have a darker surface layer than that of the Razor and Midway soils and are on the lower back slopes and on foot slopes

Similar inclusions:
• Soils that have less clay throughout
• Soils that have a darker surface layer than that of the Razor soil
• Soils that are similar to the Midway soil but have shale bedrock at a depth of 6 to 10 inches

Use and Management

Rangeland

Management concerns: Razor—wind erosion and water erosion, a slow rate of water infiltration, and the limited available water capacity; Midway—wind erosion and water erosion, a slow rate of water infiltration, the limited available water capacity, a high content of lime, which adversely affects availability of plant nutrients, and the formation of gullies along some cattle trails
Management measures:
• Proper grazing management helps to maintain plant vigor, conserves moisture, and reduces the hazard of erosion.
• Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: Razor—Vle-4; Midway—Vle-12
Range site: Razor—Clayey; Midway—Shallow Clay
Windbreak suitability group: Razor—4; Midway—10
Pasture suitability group: Razor—I; Midway—NS

RdD—Razor-Shingle complex, 6 to 15 percent slopes

Composition

Razor and similar soils: 45 to 60 percent
Shingle and similar soils: 30 to 45 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform: Dissected plains
Landform position: Razor—back slopes; Shingle—summits and shoulder slopes
Slope range: Razor—6 to 15 percent; Shingle—6 to 15 percent
Shape of areas: Irregular
Size of areas: 50 to 500 acres

Typical Profile

Razor

Surface layer:
0 to 4 inches—grayish brown silty clay

Subsoil:
4 to 14 inches—grayish brown silty clay
14 to 29 inches—light olive brown and light brownish gray, calcareous silty clay

Underlying layer:
29 to 60 inches—light yellowish brown, calcareous shale bedrock

Shingle

Surface layer:
0 to 4 inches—light olive brown, calcareous silty clay loam

Transitional layer:
4 to 9 inches—light olive brown, calcareous silty clay loam

Underlying layers:
9 to 17 inches—light yellowish brown, calcareous silty clay loam
17 to 60 inches—light yellowish brown, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Razor—well drained; Shingle—well drained
Depth to bedrock: Razor—moderately deep; Shingle—shallow
Depth to a contrasting layer: Razor—20 to 40 inches over shale bedrock; Shingle—10 to 20 inches over shale bedrock
Depth to a high water table: Razor—more than 6 feet; Shingle—more than 6 feet
Flooding: Razor—none; Shingle—none
Ponding: Razor—none; Shingle—none
Permeability: Razor—slow; Shingle—moderate in the upper part of the profile and slow in the lower part
Available water capacity: Razor—low; Shingle—low
Organic matter content: Razor—low; Shingle—low
Rate of surface runoff: Razor—very high; Shingle—very high

Inclusions

Contrasting inclusions:
• The shallow, well drained Midway soils, which contain more clay throughout than the Shingle soil and are on summits and shoulder slopes

Similar inclusions:
• Soils that are similar to the Shingle soil but have shale bedrock at a depth of 4 to 10 inches

Use and Management

Rangeland

Management concerns: Razor—wind erosion and water erosion, a slow rate of water infiltration, and the limited available water capacity; Shingle—wind erosion and water erosion, a slow rate of water infiltration, the limited available water capacity, a high content of lime, which adversely affects availability of plant nutrients, and the formation of gullies along some cattle trails
Management measures:
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
• Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: Razor—Vle-4; Shingle—Vle-11
Range site: Razor—Clayey; Shingle—Shallow
Windbreak suitability group: Razor—4; Shingle—10
Pasture suitability group: Razor—I; Shingle—NS

ReA—Ree loam, 0 to 2 percent slopes

Composition

Ree and similar soils: 90 to 99 percent

Contrasting inclusions: 1 to 10 percent

Setting

Landform: Terraces
Landform position: Summits and back slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 5 to 5,000 acres

Typical Profile

Surface layer:
0 to 8 inches—dark grayish brown loam

Subsoil:
8 to 21 inches—grayish brown clay loam
21 to 38 inches—light brownish gray, calcareous loam
38 to 45 inches—light brownish gray, calcareous sandy loam

Underlying layer:
45 to 60 inches—light brownish gray, calcareous loamy sand

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate
Rate of surface runoff: Low

Inclusions

Contrasting inclusions:
• The moderately well drained Mosher soils, which have a sodium-affected subsoil and are on foot slopes
• The moderately well drained Onita soils, which are dark to a depth of more than 20 inches and are on foot slopes
• The poorly drained Hoven soils in basins

Similar inclusions:
• Soils that contain more clay in the subsoil
• Soils that have sand and gravel within a depth of 40 inches

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, corn, oats, and alfalfa
Management concerns: Few limitations, except for the need to conserve moisture
Management measures:
• Properly managing crop residue helps to conserve moisture and maintain the content of organic matter and tilth.

Interpretive Groups

Land capability classification: IIc-2
Range site: Silty
Windbreak suitability group: 3
Pasture suitability group: F

ReB—Ree loam, 2 to 6 percent slopes

Composition

Ree and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Terraces
Landform position: Back slopes and foot slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular or long and narrow
Size of areas: 5 to 300 acres

Typical Profile

Surface layer:
0 to 8 inches—dark grayish brown loam

Subsoil:
8 to 21 inches—grayish brown clay loam
21 to 38 inches—light brownish gray, calcareous loam
38 to 45 inches—light brownish gray, calcareous sandy loam

Underlying layer:
45 to 60 inches—light brownish gray, calcareous loamy sand

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate
Rate of surface runoff: Medium

Inclusions

Contrasting inclusions:
• The moderately well drained Mosher soils, which have a sodium-affected subsoil and are on foot slopes

• The moderately well drained Onita soils, which are dark to a depth of more than 20 inches and are on foot slopes
• The poorly drained Hoven soils in basins

Similar inclusions:
• Soils that contain more clay in the subsoil
• Soils that have sand and gravel within a depth of 40 inches

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, corn, oats, and alfalfa
Management concern: Water erosion
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control water erosion.
• Stripcropping, contour farming, field windbreaks, and grassed waterways help to control water erosion.

Interpretive Groups

Land capability classification: IIe-1
Range site: Silty
Windbreak suitability group: 3
Pasture suitability group: F

RfB—Ree-Canning loams, 2 to 6 percent slopes

Composition

Ree and similar soils: 45 to 65 percent
Canning and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Terraces
Landform position: Ree—back slopes; Canning—summits and shoulder slopes
Slope range: Ree—2 to 6 percent; Canning—2 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 300 acres

Typical Profile

Ree

Surface layer:
0 to 8 inches—dark grayish brown loam

Subsoil:
8 to 21 inches—grayish brown clay loam
21 to 38 inches—light brownish gray, calcareous loam
38 to 45 inches—light brownish gray, calcareous sandy loam

Underlying layer:
45 to 60 inches—light brownish gray, calcareous loamy sand

Canning

Surface layer:
0 to 6 inches—dark grayish brown loam

Subsoil:
6 to 18 inches—dark grayish brown and brown clay loam
18 to 27 inches—pale brown, calcareous gravelly loam

Underlying layer:
27 to 60 inches—light yellowish brown, calcareous gravelly fine sand and medium sand

Soil Properties and Qualities

Drainage class: Ree—well drained; Canning—well drained
Depth to bedrock: Ree—very deep; Canning—very deep
Depth to a contrasting layer: Ree—more than 60 inches; Canning—20 to 40 inches over sand and gravel
Depth to a high water table: Ree—more than 6 feet; Canning—more than 6 feet
Flooding: Ree—none; Canning—none
Ponding: Ree—none; Canning—none
Permeability: Ree—moderate; Canning—moderate in the solum and rapid in the underlying material
Available water capacity: Ree—high; Canning—low
Organic matter content: Ree—moderate; Canning—moderate
Rate of surface runoff: Ree—medium; Canning—medium

Inclusions

Contrasting inclusions:
• The moderately well drained Mosher soils, which have a sodium-affected subsoil and are on foot slopes
• The moderately well drained Onita soils, which are dark to a depth of more than 20 inches and are on foot slopes

Similar inclusions:
• Soils that contain more clay in the subsoil than the Ree soil

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concern: Water erosion
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control water erosion.

• Stripcropping, contour farming, and grassed waterways help to control water erosion.

Interpretive Groups

Land capability classification: Ree—IIe-1; Canning—IIIe-6
Range site: Ree—Silty; Canning—Silty
Windbreak suitability group: Ree—3; Canning—6
Pasture suitability group: Ree—F; Canning—D1

RfC—Ree-Canning loams, 6 to 9 percent slopes

Composition

Ree and similar soils: 45 to 60 percent
Canning and similar soils: 35 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Terraces
Landform position: Ree—back slopes; Canning—summits and shoulder slopes
Slope range: Ree—6 to 9 percent; Canning—6 to 9 percent
Shape of areas: Irregular
Size of areas: 10 to 75 acres

Typical Profile

Ree

Surface layer:
0 to 8 inches—dark grayish brown loam

Subsoil:
8 to 21 inches—grayish brown clay loam
21 to 38 inches—light brownish gray, calcareous loam
38 to 45 inches—light brownish gray, calcareous sandy loam

Underlying layer:
45 to 60 inches—light brownish gray, calcareous loamy sand

Canning

Surface layer:
0 to 6 inches—dark grayish brown loam

Subsoil:
6 to 18 inches—dark grayish brown and brown clay loam
18 to 27 inches—pale brown, calcareous gravelly loam

Underlying layer:
27 to 60 inches—light yellowish brown, calcareous gravelly fine sand and medium sand

Soil Properties and Qualities

Drainage class: Ree—well drained; Canning—well drained
Depth to bedrock: Ree—very deep; Canning—very deep
Depth to a contrasting layer: Ree—more than 60 inches; Canning—20 to 40 inches over sand and gravel
Depth to a high water table: Ree—more than 6 feet; Canning—more than 6 feet
Flooding: Ree—none; Canning—none
Ponding: Ree—none; Canning—none
Permeability: Ree—moderate; Canning—moderate in the solum and rapid in the underlying material
Available water capacity: Ree—high; Canning—low
Organic matter content: Ree—moderate; Canning—moderate
Rate of surface runoff: Ree—medium; Canning—medium

Inclusions

Contrasting inclusions:
• The somewhat excessively drained Vivian soils, which have gravelly material within a depth of 10 inches and are on summits and shoulder slopes

Similar inclusions:
• Soils that contain more clay in the subsoil than the Ree soil

Use and Management

Cropland

Main crops: Winter wheat, oats, and alfalfa
Management consideration: The Canning soil is poorly suited to cropland.
Management concern: Water erosion
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control water erosion.
• Stripcropping, contour farming, terracing, and grassed waterways help to control water erosion.

Interpretive Groups

Land capability classification: Ree—IIIe-1; Canning—IVe-5
Range site: Ree—Silty; Canning—Silty
Windbreak suitability group: Ree—3; Canning—6
Pasture suitability group: Ree—F; Canning—D1

Rh—Ree-Hoven complex

Composition

Ree and similar soils: 70 to 90 percent
Hoven and similar soils: 10 to 15 percent

Contrasting inclusions: 1 to 10 percent

Setting

Landform: Terraces
Landform position: Ree—summits and back slopes; Hoven—basins
Slope range: Ree—0 to 2 percent; Hoven—0 to 1 percent
Shape of areas: Irregular
Size of areas: 5 to 150 acres

Typical Profile

Ree

Surface layer:
0 to 8 inches—dark grayish brown loam

Subsoil:
8 to 21 inches—grayish brown clay loam
21 to 38 inches—light brownish gray, calcareous loam
38 to 45 inches—light brownish gray, calcareous sandy loam

Underlying layer:
45 to 60 inches—light brownish gray, calcareous loamy sand

Hoven

Surface layer:
0 to 3 inches—gray silt loam

Subsoil:
3 to 23 inches—dark gray silty clay
23 to 33 inches—dark gray, calcareous silty clay

Underlying layers:
33 to 45 inches—grayish brown, calcareous silty clay that has a few masses of gypsum and other salts
45 to 60 inches—grayish brown, calcareous silty clay that has many masses of gypsum and other salts

Soil Properties and Qualities

Drainage class: Ree—well drained; Hoven—poorly drained
Depth to bedrock: Ree—very deep; Hoven—very deep
Depth to a contrasting layer: Ree—more than 60 inches; Hoven—more than 60 inches
Water table: Ree—at a depth of more than 6.0 feet; Hoven—1.0 foot above to 1.5 feet below the surface
Flooding: Ree—none; Hoven—none
Ponding: Ree—none; Hoven—occasional, for long periods
Permeability: Ree—moderate; Hoven—very slow
Available water capacity: Ree—high; Hoven—moderate
Organic matter content: Ree—moderate; Hoven—moderate
Rate of surface runoff: Ree—low; Hoven—negligible

Inclusions

Contrasting inclusions:
• The moderately well drained Mosher soils, which have a sodium-affected subsoil and are on foot slopes
• The moderately well drained Onita soils, which are dark to a depth of more than 20 inches and are on foot slopes

Similar inclusions:
• Soils that contain more clay in the subsoil than the Ree soil

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, corn, oats, and alfalfa
Management consideration: The Hoven soil is unsuited to cropland.
Management concerns: Ree—few limitations, except for the need to conserve moisture; Hoven—wetness and compaction in areas that are grazed when wet
Management measures:
• Properly managing crop residue helps to conserve moisture and maintain the content of organic matter and tilth.
• If the Hoven soil is tilled, the crop rotation should include grasses and legumes, which improve tilth and increase the rate of water infiltration.
• Chiseling or subsoiling during dry periods increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Ree—IIc-2; Hoven—VIs-1
Range site: Ree—Silty; Hoven—Closed Depression
Windbreak suitability group: Ree—3; Hoven—10
Pasture suitability group: Ree—F; Hoven—B2

RkD—Ree-Vivian complex, 6 to 15 percent slopes

Composition

Ree and similar soils: 50 to 70 percent
Vivian and similar soils: 25 to 35 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Terraces
Landform position: Ree—back slopes; Vivian—summits and shoulder slopes
Slope range: Ree—6 to 9 percent; Vivian—6 to 15 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

Ree

Surface layer:
0 to 8 inches—dark grayish brown loam

Subsoil:
8 to 21 inches—grayish brown clay loam
21 to 38 inches—light brownish gray, calcareous loam
38 to 45 inches—light brownish gray, calcareous sandy loam

Underlying layer:
45 to 60 inches—light brownish gray, calcareous loamy sand

Vivian

Surface layer:
0 to 3 inches—grayish brown, calcareous gravelly loam

Transitional layer:
3 to 10 inches—light olive brown, calcareous gravelly loam

Underlying layers:
10 to 50 inches—light yellowish brown, calcareous very gravelly loam
50 to 60 inches—light brownish gray, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Ree—well drained; Vivian—somewhat excessively drained
Depth to bedrock: Ree—very deep; Vivian—deep
Depth to a contrasting layer: Ree—more than 60 inches; Vivian—40 to 60 inches over shale bedrock
Depth to a high water table: Ree—more than 6 feet; Vivian—more than 6 feet
Flooding: Ree—none; Vivian—none
Ponding: Ree—none; Vivian—none
Permeability: Ree—moderate; Vivian—moderately rapid in the upper part of the profile and very slow in the lower part
Available water capacity: Ree—high; Vivian—low
Organic matter content: Ree—moderate; Vivian—low
Rate of surface runoff: Ree—medium; Vivian—high
Other properties: The Vivian soil has a high content of lime.

Inclusions

Similar inclusions:
• Soils that contain less gravel throughout than the Vivian soil
• Soils that contain more clay in the subsoil than the Ree soil
• Soils that are similar to the Ree soil but have gravelly material at a depth of 20 to 40 inches
• Soils that contain more sand than the Vivian soil

Use and Management

Dominant uses: Most of the acreage is used as pasture or range.

Cropland and pasture

Management consideration: The Vivian soil is unsuited to cropland.
Management concerns: Ree—water erosion; Vivian—wind erosion and water erosion, the high content of lime, which adversely affects the availability of plant nutrients, the limited available water capacity, and the formation of gullies along some cattle trails
Management measures:
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
• Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: Ree—IIIe-1; Vivian—VIe-5
Range site: Ree—Silty; Vivian—Thin Upland
Windbreak suitability group: Ree—3; Vivian—10
Pasture suitability group: Ree—F; Vivian—NS

Rv—Riverwash

Composition

Riverwash: 80 to 99 percent
Contrasting inclusions: 1 to 20 percent

Setting

Landform: Flood plains along the Cheyenne River
Landform position: Low flood plains
Slope range: 0 to 4 percent
Shape of areas: Long and narrow
Size of areas: 5 to 50 acres

Soil Properties and Qualities

Surface layer: Gravelly and sandy sediments occurring as sandbars
Drainage class: Somewhat excessively drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: 0 to 3 feet
Flooding: Frequent, for brief periods
Ponding: None
Permeability: Very rapid
Available water capacity: Very low
Organic matter content: Low
Rate of surface runoff: Very low

Inclusions

Contrasting inclusions:
• The well drained Craft soils on the higher flood plains
• The well drained Haverson soils on the higher flood plains
• The somewhat excessively drained Bankard soils on the higher flood plains

Use and Management

Dominant use: Most of the acreage is used as habitat for wildlife.

Wildlife habitat

Management considerations: Most areas support little or no vegetation, but willows and cottonwood seedlings grow in some areas.
Management concerns: Flooding and the limited available water capacity

Interpretive Groups

Land capability classification: VIIIe-1
Range site: None
Windbreak suitability group: 10
Pasture suitability group: NS

SbF—Samsil clay, 25 to 60 percent slopes

Composition

Samsil and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform: Dissected plains
Landform position: Shoulder slopes and back slopes
Slope range: 25 to 60 percent
Shape of areas: Irregular
Size of areas: 15 to 1,500 acres

Typical Profile

Surface layer:
0 to 4 inches—grayish brown, calcareous clay

Transitional layer:
4 to 8 inches—grayish brown, calcareous clay

Underlying layers:
8 to 14 inches—light brownish gray, calcareous clay
14 to 60 inches—light brownish gray, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Shallow
Depth to contrasting parent material: 10 to 20 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: Low
Organic matter content: Low
Rate of surface runoff: Very high

Inclusions

Contrasting inclusions:
• The excessively drained Schamber soils, which have gravelly underlying layers and are on summits and shoulder slopes
• Rock outcrop, which consists of exposed shale bedrock on steep back slopes along drainageways
• The very deep, dense Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of fans and terraces

Similar inclusions:
• Soils that contain more carbonates throughout
• Soils that have shale bedrock at a depth of 6 to 10 inches

Use and Management

Rangeland

Management concerns: Wind erosion and water erosion, the slope, a slow rate of water infiltration, the limited available water capacity, the limited depth to bedrock, a high content of lime, which adversely affects the availability of plant nutrients, and the formation of gullies along some cattle trails
Management measures:
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
• Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: VIIe-8
Range site: Shallow Clay
Windbreak suitability group: 10
Pasture suitability group: NS

ScF—Samsil-Nihill complex, 6 to 40 percent slopes

Composition

Samsil and similar soils: 60 to 70 percent
Nihill and similar soils: 15 to 20 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Dissected plains
Landform position: Samsil—back slopes; Nihill—summits and shoulder slopes
Slope range: Samsil—6 to 40 percent; Nihill—6 to 40 percent
Shape of areas: Irregular
Size of areas: 30 to 600 acres

Typical Profile

Samsil

Surface layer:
0 to 4 inches—grayish brown, calcareous clay

Transitional layer:
4 to 8 inches—grayish brown, calcareous clay

Underlying layers:
8 to 14 inches—light brownish gray, calcareous clay
14 to 60 inches—light brownish gray, calcareous shale bedrock

Nihill

Surface layer:
0 to 9 inches—grayish brown, calcareous gravelly loam

Underlying layer:
9 to 60 inches—pale yellow, calcareous very gravelly loam

Soil Properties and Qualities

Drainage class: Samsil—well drained; Nihill—well drained
Depth to bedrock: Samsil—shallow; Nihill—very deep
Depth to a contrasting layer: Samsil—10 to 20 inches over shale bedrock; Nihill—more than 60 inches
Depth to a high water table: Samsil—more than 6 feet; Nihill—more than 6 feet
Flooding: Samsil—none; Nihill—none
Ponding: Samsil—none; Nihill—none
Permeability: Samsil—slow; Nihill—moderate
Available water capacity: Samsil—low; Nihill—low
Organic matter content: Samsil—low; Nihill—low
Rate of surface runoff: Samsil—high or very high; Nihill—medium to very high
Other properties: The Nihill soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The very deep, well drained Nunn soils on the lower foot slopes
• The moderately deep, well drained Lakoma soils on back slopes
• The very deep, dense Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of fans and terraces

Similar inclusions:
• Soils that contain more sand throughout than the Nihill soil
• Soils that contain less gravel than the Nihill soil
• Soils that are similar to the Samsil soil but have shale bedrock at a depth of 6 to 10 inches

Use and Management

Rangeland

Management concerns: Samsil—wind erosion and water erosion, the slope, a slow rate of water infiltration, the limited available water capacity, a high content of lime, which adversely affects the availability of plant nutrients, the limited depth to bedrock, and the formation of gullies along some cattle trails; Nihill—water erosion, the slope, a slow rate of water infiltration, the limited available water capacity, and the formation of gullies along some cattle trails
Management measures:
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
• Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: Samsil—VIIe-8; Nihill—VIIs-4
Range site: Samsil—Shallow Clay; Nihill—Very Shallow
Windbreak suitability group: Samsil—10; Nihill—10
Pasture suitability group: Samsil—NS; Nihill—NS

SdF—Samsil-Rock outcrop complex, 15 to 60 percent slopes

Composition

Samsil and similar soils: 50 to 60 percent
Rock outcrop: 25 to 35 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Dissected plains
Landform position: Samsil—shoulder slopes and the upper back slopes; Rock outcrop—back slopes
Slope range: Samsil—15 to 60 percent; Rock outcrop—15 to 60 percent
Shape of areas: Irregular
Size of areas: 20 to 100 acres

Typical Profile

Samsil

Surface layer:
0 to 4 inches—grayish brown, calcareous clay

Transitional layer:
4 to 8 inches—grayish brown, calcareous clay

Underlying layers:
8 to 14 inches—light brownish gray, calcareous clay
14 to 60 inches—light brownish gray, calcareous shale bedrock

Characteristics of the Rock Outcrop

- Eroding exposures of soft bedrock barren of vegetation
- In places 1 to 5 inches of loose, weathered material on the surface

Soil Properties and Qualities

Drainage class: Samsil—well drained; Rock outcrop—none
Depth to bedrock: Samsil—shallow; Rock outcrop—none
Depth to a contrasting layer: Samsil—10 to 20 inches over shale bedrock; Rock outcrop—0 to 1 inch over soft bedrock
Depth to a high water table: Samsil—more than 6 feet; Rock outcrop—more than 6 feet
Flooding: Samsil—none; Rock outcrop—none
Ponding: Samsil—none; Rock outcrop—none
Permeability: Samsil—slow; Rock outcrop—very slow
Available water capacity: Samsil—low; Rock outcrop—very low
Organic matter content: Samsil—low; Rock outcrop—low
Rate of surface runoff: Samsil—very high; Rock outcrop—very high

Inclusions

Contrasting inclusions:
- The excessively drained Schamber soils, which have gravelly underlying layers and are on summits and shoulder slopes
- The moderately deep Pierre soils on the lower back slopes

Similar inclusions:
- Soils that contain more carbonates throughout than the Samsil soil
- Soils that are similar to the Samsil soil but have shale bedrock at a depth of 6 to 10 inches

Use and Management

Rangeland

Management concerns: Samsil—wind erosion and water erosion, the slope, a slow rate of water infiltration, a high content of lime, which adversely affects the availability of plant nutrients, and the formation of gullies along some cattle trails; Rock outcrop—areas of exposed bedrock
Management measures:
- Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
- Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: Samsil—VIIe-8; Rock outcrop—VIIIs-1
Range site: Samsil—Shallow Clay; Rock outcrop—none
Windbreak suitability group: Samsil—10; Rock outcrop—10
Pasture suitability group: Samsil—NS; Rock outcrop—NS

SoE—Sansarc-Opal clays, 9 to 40 percent slopes

Composition

Sansarc and similar soils: 55 to 70 percent
Opal and similar soils: 20 to 40 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Dissected plains
Landform position: Sansarc—shoulder slopes and the upper back slopes; Opal—back slopes
Slope range: Sansarc—9 to 40 percent; Opal—9 to 25 percent
Shape of areas: Irregular
Size of areas: 15 to 200 acres

Typical Profile

Sansarc

Surface layer:
0 to 4 inches—grayish brown, calcareous clay

Transitional layer:
4 to 8 inches—grayish brown, calcareous clay

Underlying layers:
8 to 15 inches—light brownish gray, calcareous clay
15 to 60 inches—light brownish gray, calcareous shale bedrock

Opal

Surface layer:
0 to 6 inches—dark gray and dark grayish brown, calcareous clay

Subsoil:
6 to 26 inches—dark grayish brown, calcareous clay
26 to 33 inches—grayish brown, calcareous clay

Underlying layers:
33 to 36 inches—light brownish gray, calcareous clay
36 to 60 inches—light brownish gray shale bedrock

Soil Properties and Qualities

Drainage class: Sansarc—well drained; Opal—well drained
Depth to bedrock: Sansarc—shallow; Opal—moderately deep
Depth to a contrasting layer: Sansarc—10 to 20 inches over shale bedrock; Opal—20 to 40 inches over shale bedrock
Depth to a high water table: Sansarc—more than 6 feet; Opal—more than 6 feet
Flooding: Sansarc—none; Opal—none
Ponding: Sansarc—none; Opal—none
Permeability: Sansarc—slow; Opal—very slow
Available water capacity: Sansarc—very low; Opal—low
Organic matter content: Sansarc—low; Opal—moderate
Rate of surface runoff: Sansarc—very high; Opal—very high

Inclusions

Contrasting inclusions:
• The very deep, moderately well drained Capa soils, which have a sodium-affected subsoil and are on foot slopes
• The very deep, dense Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of fans and terraces
• The very deep, very poorly drained Herdcamp soils on low flood plains

Similar inclusions:
• Soils that do not have bedded shale bedrock within a depth of 40 inches
• Soils that have a lighter colored surface layer
• Soils that are similar to the Sansarc soil but have shale bedrock at a depth of 6 to 10 inches

Use and Management

Rangeland

Management concerns: Sansarc—wind erosion and water erosion, the slope, a slow rate of water infiltration, the limited available water capacity, a high content of lime, which adversely affects the availability of plant nutrients, and the formation of gullies along some cattle trails; Opal—wind erosion and water erosion, a slow rate of water infiltration, the limited available water capacity, and the formation of gullies along some cattle trails
Management measures:
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
• Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: Sansarc—VIIe-8; Opal—VIe-4
Range site: Sansarc—Shallow Clay; Opal—Clayey
Windbreak suitability group: Sansarc—10; Opal—10
Pasture suitability group: Sansarc—NS; Opal—NS

SrA—Savo silt loam, 0 to 2 percent slopes

Composition

Savo and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Plains
Landform position: Back slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 5 to 200 acres

Typical Profile

Surface layer:
0 to 6 inches—grayish brown silt loam

Subsoil:
6 to 13 inches—grayish brown silty clay loam
13 to 20 inches—light olive brown silty clay loam
20 to 35 inches—grayish brown, calcareous silty clay loam
35 to 60 inches—light yellowish brown, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderate
Rate of surface runoff: Low

Inclusions

Contrasting inclusions:
• The very deep Ottumwa soils, which contain more clay throughout than the Savo soil and are on foot slopes
• The moderately deep, moderately well drained Wortman soils, which have a sodium-affected subsoil and are on foot slopes

Similar inclusions:
- Soils that have a lighter colored surface layer
- Soils that have more sand in the subsoil

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concerns: Few limitations, except for the need to conserve moisture
Management measures:
- Properly managing crop residue helps to conserve moisture and maintain the content of organic matter and tilth.

Interpretive Groups

Land capability classification: IIc-2
Range site: Silty
Windbreak suitability group: 3
Pasture suitability group: F

SrB—Savo silt loam, 2 to 6 percent slopes

Composition

Savo and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Plains
Landform position: Back slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 200 acres

Typical Profile

Surface layer:
0 to 6 inches—grayish brown silt loam

Subsoil:
6 to 13 inches—grayish brown silty clay loam
13 to 20 inches—light olive brown silty clay loam
20 to 35 inches—grayish brown, calcareous silty clay loam
35 to 60 inches—light yellowish brown, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderate
Rate of surface runoff: Medium

Inclusions

Contrasting inclusions:
- The very deep Ottumwa soils, which contain more clay throughout than the Savo soil and are on foot slopes
- The moderately deep, moderately well drained Wortman soils, which have a sodium-affected subsoil and are on foot slopes
- The moderately deep Razor soils on summits and shoulder slopes

Similar inclusions:
- Soils that have a lighter colored surface layer
- Soils that have more sand in the subsoil

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, oats, and alfalfa
Management concern: Water erosion
Management measures:
- Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control water erosion.
- Stripcropping, contour farming, and grassed waterways help to control water erosion.

Interpretive Groups

Land capability classification: IIe-1
Range site: Silty
Windbreak suitability group: 3
Pasture suitability group: F

SrC—Savo silt loam, 6 to 9 percent slopes

Composition

Savo and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Plains
Landform position: Back slopes
Slope range: 6 to 9 percent
Shape of areas: Irregular
Size of areas: 10 to 75 acres

Typical Profile

Surface layer:
0 to 6 inches—grayish brown silt loam

Subsoil:
6 to 13 inches—grayish brown silty clay loam
13 to 20 inches—light olive brown silty clay loam
20 to 35 inches—grayish brown, calcareous silty clay loam
35 to 60 inches—light yellowish brown, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderate
Rate of surface runoff: High

Inclusions

Contrasting inclusions:
• The moderately deep Blackpipe soils in positions on the landscape similar to those of the Savo soil
• The very deep Kyle soils, which contain more clay throughout than the Savo soil and are on foot slopes
• The moderately well drained Mosher soils, which have a sodium-affected subsoil and are on foot slopes

Use and Management

Cropland

Main crops: Winter wheat, oats, and alfalfa
Management concern: Water erosion
Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface help to conserve moisture and control water erosion.
• Stripcropping, contour farming, terraces, and grassed waterways help to control water erosion.

Interpretive Groups

Land capability classification: IIIe-1
Range site: Silty
Windbreak suitability group: 3
Pasture suitability group: F

StF—Schamber-Samsil complex, 6 to 60 percent slopes

Composition

Schamber and similar soils: 45 to 60 percent
Samsil and similar soils: 30 to 50 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Dissected plains
Landform position: Schamber—summits and shoulder slopes; Samsil—back slopes
Slope range: Schamber—6 to 60 percent; Samsil—6 to 60 percent
Shape of areas: Irregular
Size of areas: 50 to 5,000 acres

Typical Profile

Schamber

Surface layer:
0 to 6 inches—dark grayish brown gravelly loam

Underlying layer:
6 to 60 inches—pale brown very gravelly sand

Samsil

Surface layer:
0 to 4 inches—grayish brown, calcareous clay

Transitional layer:
4 to 8 inches—grayish brown, calcareous clay

Underlying layers:
8 to 14 inches—light brownish gray, calcareous clay
14 to 60 inches—light brownish gray, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Schamber—somewhat excessively drained; Samsil—well drained
Depth to bedrock: Schamber—very deep; Samsil—shallow
Depth to a contrasting layer: Schamber—4 to 10 inches over sand and gravel; Samsil—10 to 20 inches over shale bedrock
Depth to a high water table: Schamber—more than 6 feet; Samsil—more than 6 feet
Flooding: Schamber—none; Samsil—none
Ponding: Schamber—none; Samsil—none
Permeability: Schamber—rapid; Samsil—slow
Available water capacity: Schamber—low; Samsil—low
Organic matter content: Schamber—low; Samsil—low
Rate of surface runoff: Schamber—medium; Samsil—very high

Inclusions

Contrasting inclusions:
• Rock outcrop, which consists of exposed shale bedrock on steep back slopes along drainageways
• The well drained Canning soils, which have gravelly

material at a depth of 20 to 40 inches and are on back slopes
• The moderately deep Pierre soils on back slopes

Similar inclusions:
• Soils that contain more carbonates than the Samsil soil
• Soils that contain less sand and gravel than the Schamber soil
• Soils that are similar to the Samsil soil but have shale bedrock at a depth of 6 to 10 inches

Use and Management

Rangeland

Management concerns: Schamber—water erosion, the limited available water capacity, the slope, and the formation of gullies along some cattle trails; Samsil—wind erosion and water erosion, the slope, a slow rate of water infiltration, the limited available water capacity, the limited depth to bedrock, and the formation of gullies along some cattle trails
Management measures:
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
• Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: Schamber—VIIs-4; Samsil—VIIe-8
Range site: Schamber—Very Shallow; Samsil—Shallow Clay
Windbreak suitability group: Schamber—10; Samsil—10
Pasture suitability group: Schamber—NS; Samsil—NS

SuE—Shingle silty clay loam, 15 to 40 percent slopes

Composition

Shingle and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform: Dissected plains
Landform position: Shoulder slopes and back slopes
Slope range: 15 to 40 percent
Shape of areas: Irregular
Size of areas: 10 to 50 acres

Typical Profile

Surface layer:
0 to 4 inches—light olive brown, calcareous silty clay loam

Transitional layer:
4 to 9 inches—light olive brown, calcareous silty clay loam

Underlying layers:
9 to 17 inches—light yellowish brown, calcareous silty clay loam
17 to 60 inches—light yellowish brown, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Shallow
Depth to contrasting parent material: 10 to 20 inches over shale bedrock
Depth to a high water table: More than 6 feet
Flooding: None
Ponding: None
Permeability: Moderate in the upper part of the profile and slow in the lower part
Available water capacity: Low
Organic matter content: Low
Rate of surface runoff: Very high

Inclusions

Contrasting inclusions:
• The shallow, well drained Midway soils, which contain more clay throughout than the Shingle soil and are on shoulder slopes and the upper back slopes
• The moderately deep, well drained Razor soils on the lower back slopes

Similar inclusions:
• Soils that have shale bedrock at a depth of 4 to 10 inches

Use and Management

Rangeland

Management concerns: Wind erosion and water erosion, the slope, the limited depth to bedrock, a slow rate of water infiltration, the limited available water capacity, a high content of lime, which adversely affects the availability of plant nutrients, and the formation of gullies along some cattle trails
Management measures:
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
• Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: VIIe-7
Range site: Shallow
Windbreak suitability group: 10
Pasture suitability group: NS

SwE—Shingle-Razor complex, 15 to 25 percent slopes

Composition

Shingle and similar soils: 50 to 60 percent
Razor and similar soils: 35 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Dissected plains
Landform position: Shingle—summits and shoulder slopes; Razor—back slopes
Slope range: Shingle—15 to 25 percent; Razor—15 to 25 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Shingle

Surface layer:
0 to 4 inches—light olive brown, calcareous silty clay loam

Transitional layer:
4 to 9 inches—light olive brown, calcareous silty clay loam

Underlying layers:
9 to 17 inches—light yellowish brown, calcareous silty clay loam
17 to 60 inches—light yellowish brown, calcareous shale bedrock

Razor

Surface layer:
0 to 4 inches—grayish brown silty clay

Subsoil:
4 to 14 inches—grayish brown silty clay
14 to 29 inches—light olive brown and light brownish gray, calcareous silty clay

Underlying layer:
29 to 60 inches—light yellowish brown, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Shingle—well drained; Razor—well drained
Depth to bedrock: Shingle—shallow; Razor—moderately deep
Depth to a contrasting layer: Shingle—10 to 20 inches over shale bedrock; Razor—20 to 40 inches over shale bedrock
Depth to a high water table: Shingle—more than 6 feet; Razor—more than 6 feet
Flooding: Shingle—none; Razor—none
Ponding: Shingle—none; Razor—none
Permeability: Shingle—moderate in the upper part of the profile and slow in the lower part; Razor—slow
Available water capacity: Shingle—low; Razor—low
Organic matter content: Shingle—low; Razor—low
Rate of surface runoff: Shingle—very high; Razor—very high

Inclusions

Contrasting inclusions:
• The shallow, well drained Midway soils, which contain more clay throughout than the Shingle soil and are on shoulder slopes and the upper back slopes

Similar inclusions:
• Soils that are similar to the Shingle soil but have shale bedrock at a depth of 4 to 10 inches

Use and Management

Rangeland

Management concerns: Shingle—wind erosion and water erosion, the slope, the limited depth to bedrock, a slow rate of water infiltration, the limited available water capacity, a high content of lime, which adversely affects the availability of plant nutrients, and the formation of gullies along some cattle trails; Razor—wind erosion and water erosion, a slow rate of water infiltration, and the limited available water capacity
Management measures:
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
• Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: Shingle—VIe-7; Razor—VIe-4
Range site: Shingle—Shallow; Razor—Clayey
Windbreak suitability group: Shingle—10; Razor—10
Pasture suitability group: Shingle—NS; Razor—NS

Wc—Wendte silty clay

Composition

Wendte and similar soils: 80 to 99 percent
Contrasting inclusions: 1 to 20 percent

Setting

Landform: Flood plains
Landform position: High flood plains
Slope range: 0 to 2 percent
Shape of areas: Long and narrow

Size of areas: 10 to 250 acres

Typical Profile

Surface layer:
0 to 6 inches—grayish brown, calcareous silty clay

Underlying layers:
6 to 42 inches—grayish brown, calcareous, stratified clay
42 to 60 inches—light brownish gray, calcareous, stratified silty clay loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Depth to bedrock: Very deep
Depth to contrasting parent material: More than 60 inches
Depth to a high water table: 3.5 to 5.0 feet
Flooding: Rare
Ponding: None
Permeability: Slow
Available water capacity: Moderate
Organic matter content: Moderate
Rate of surface runoff: Medium

Inclusions

Contrasting inclusions:
• The very deep, dense Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of fans and terraces
• The well drained Nimbro, Haverson, and Craft soils, which contain less clay throughout than the Wendte soil and are in positions on the landscape similar to those of the Wendte soil

Similar inclusions:
• Soils that have silty material within a depth of 40 inches

Use and Management

Cropland

Main crops: Winter wheat, grain sorghum, and alfalfa
Management concerns: Wind erosion, a slow rate of water infiltration, and a high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to conserve moisture, control erosion, maintain fertility, and improve tilth.
• Stripcropping and field windbreaks help to control wind erosion.
• Chiseling or subsoiling improves tilth and increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIs-3
Range site: Clayey Overflow
Windbreak suitability group: 4
Pasture suitability group: I

Wd—Wendte-Herdcamp silty clays, channeled

Composition

Wendte and similar soils: 50 to 65 percent
Herdcamp and similar soils: 15 to 30 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Flood plains
Landform position: Wendte—high flood plains; Herdcamp—low flood plains
Slope range: Wendte—0 to 2 percent; Herdcamp—0 to 2 percent
Shape of areas: Long and narrow
Size of areas: 10 to 200 acres

Typical Profile

Wendte

Surface layer:
0 to 6 inches—grayish brown, calcareous silty clay

Underlying layers:
6 to 42 inches—grayish brown, calcareous, stratified clay
42 to 60 inches—light brownish gray, calcareous, stratified silty clay loam

Herdcamp

Surface layer:
0 to 5 inches—dark gray, mottled, calcareous silty clay that has nests of gypsum and other salts

Underlying layers:
5 to 27 inches—gray, mottled, calcareous silty clay that has nests of gypsum and other salts
27 to 60 inches—gray, mottled, calcareous clay that has nests of gypsum and other salts

Soil Properties and Qualities

Drainage class: Wendte—moderately well drained; Herdcamp—very poorly drained
Depth to bedrock: Wendte—very deep; Herdcamp—very deep
Depth to a contrasting layer: Wendte—more than 60 inches; Herdcamp—more than 60 inches
Depth to a high water table: Wendte—3.5 to 5.0 feet; Herdcamp—0 to 1.0 foot
Flooding: Wendte—occasional, for brief periods; Herdcamp—frequent, for brief periods

Ponding: Wendte—none; Herdcamp—none
Permeability: Wendte—slow; Herdcamp—slow
Available water capacity: Wendte—moderate; Herdcamp—moderate
Organic matter content: Wendte—moderate; Herdcamp—moderate
Rate of surface runoff: Wendte—medium; Herdcamp—medium
Other properties: Both soils are dissected by meandering stream channels.

Inclusions

Contrasting inclusions:
• The very deep, dense Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of fans and terraces
• The well drained Nimbro soils, which contain less clay throughout than the Wendte and Herdcamp soils and are in positions on the landscape similar to those of the Wendte soil
• The poorly drained Egas soils, which have visible salts within a depth of 6 inches and are in positions on the landscape similar to those of the Herdcamp soil

Use and Management

Rangeland

Management concerns: Meandering channels, wetness, a slow rate of water infiltration, wind erosion, a high content of lime, which adversely affects the availability of plant nutrients, and compaction in areas that are grazed when wet
Management measures:
• Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.

Interpretive Groups

Land capability classification: Wendte—VIw-1; Herdcamp—VIw-2
Range site: Wendte—Clayey Overflow; Herdcamp—Wetland
Windbreak suitability group: Wendte—4; Herdcamp—10
Pasture suitability group: Wendte—NS; Herdcamp—NS

WsE—Wendte, channeled-Sansarc complex, 0 to 60 percent slopes

Composition

Wendte and similar soils: 40 to 65 percent
Sansarc and similar soils: 30 to 40 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Flood plains and dissected plains
Landform position: Wendte—high flood plains; Sansarc—shoulder slopes and back slopes
Slope range: Wendte—0 to 2 percent; Sansarc—25 to 60 percent
Shape of areas: Long and narrow
Size of areas: 40 to 500 acres

Typical Profile

Wendte

Surface layer:
0 to 6 inches—grayish brown, calcareous silty clay

Underlying layers:
6 to 42 inches—grayish brown, calcareous, stratified clay
42 to 60 inches—light brownish gray, calcareous, stratified silty clay loam

Sansarc

Surface layer:
0 to 4 inches—grayish brown, calcareous clay

Transitional layer:
4 to 8 inches—grayish brown, calcareous clay

Underlying layers:
8 to 15 inches—light brownish gray, calcareous clay
15 to 60 inches—light brownish gray, calcareous shale bedrock

Soil Properties and Qualities

Drainage class: Wendte—moderately well drained; Sansarc—well drained
Depth to bedrock: Wendte—very deep; Sansarc—shallow
Depth to a contrasting layer: Wendte—more than 60 inches; Sansarc—10 to 20 inches over shale bedrock
Depth to a high water table: Wendte—3.5 to 5.0 feet; Sansarc—more than 6.0 feet
Flooding: Wendte—occasional, for brief periods; Sansarc—none
Ponding: Wendte—none; Sansarc—none
Permeability: Wendte—slow; Sansarc—slow
Available water capacity: Wendte—moderate; Sansarc—very low
Organic matter content: Wendte—moderate; Sansarc—low
Rate of surface runoff: Wendte—medium; Sansarc—very high
Other properties: The Wendte soil typically is dissected by meandering channels.

Inclusions

Contrasting inclusions:

- The very deep, dense Bullcreek soils, which have visible salts within a depth of 20 inches and are on the foot slopes of fans and terraces
- The well drained Nimbro soils, which contain less clay throughout than the Wendte and Sansarc soils and are in positions on the landscape similar to those of the Wendte soil
- The poorly drained Egas soils, which have visible salts within a depth of 6 inches and are on low flood plains
- The very poorly drained Herdcamp soils on the lowest part of the landscape

Similar inclusions:

- Soils that are similar to the Sansarc soil but have shale bedrock at a depth of 6 to 10 inches

Use and Management

Rangeland

Management concerns: Wendte—meandering channels, wetness, a slow rate of water infiltration, wind erosion, and a high content of lime, which adversely affects the availability of plant nutrients; Sansarc—wind erosion and water erosion, the slope, the limited depth to bedrock, the limited available water capacity, a slow rate of water infiltration, and the formation of gullies along some cattle trails

Management measures:

- Proper grazing management helps to maintain plant vigor, conserve moisture, and control erosion.
- Fencing and other means of controlling livestock traffic patterns help to prevent the formation of gullies.

Interpretive Groups

Land capability classification: Wendte—VIw-1; Sansarc—VIIe-8
Range site: Wendte—Clayey Overflow; Sansarc—Shallow Clay
Windbreak suitability group: Wendte—4; Sansarc—10
Pasture suitability group: Wendte—NS; Sansarc—NS

Ww—Wortman-Wanblee silt loams, 0 to 2 percent slopes

Composition

Wortman and similar soils: 45 to 55 percent
Wanblee and similar soils: 25 to 40 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Plains
Landform position: Wortman—foot slopes; Wanblee—the lower foot slopes
Slope range: Wortman—0 to 2 percent; Wanblee—0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Wortman

Surface layer:
0 to 5 inches—grayish brown silt loam

Subsoil:
5 to 8 inches—dark grayish brown clay
8 to 13 inches—grayish brown clay
13 to 18 inches—grayish brown, calcareous silty clay loam

Underlying layers:
18 to 36 inches—light olive brown, calcareous silty clay loam
36 to 60 inches—light reddish brown, calcareous siltstone bedrock

Wanblee

Surface layer:
0 to 2 inches—light brownish gray silt loam

Subsoil:
2 to 9 inches—dark grayish brown clay
9 to 16 inches—grayish brown, calcareous silty clay loam that has masses of gypsum and other salts

Underlying layers:
16 to 27 inches—pale brown, calcareous silty clay loam that has masses of gypsum and other salts
27 to 60 inches—pale olive and olive gray, calcareous siltstone bedrock

Soil Properties and Qualities

Drainage class: Wortman—moderately well drained; Wanblee—moderately well drained
Depth to bedrock: Wortman—moderately deep; Wanblee—moderately deep
Depth to a contrasting layer: Wortman—20 to 40 inches over siltstone bedrock; Wanblee—20 to 40 inches over siltstone bedrock
Depth to a high water table: Wortman—more than 6 feet; Wanblee—more than 6 feet
Flooding: Wortman—none; Wanblee—none
Ponding: Wortman—none; Wanblee—none
Permeability: Wortman—very slow; Wanblee—very slow
Available water capacity: Wortman—low; Wanblee—low
Organic matter content: Wortman—moderate; Wanblee—moderate

Rate of surface runoff: Wortman—medium; Wanblee—medium

Other properties: Both soils have a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• The well drained Blackpipe soils, which do not have a sodium-affected subsoil and are on summits and back slopes

Use and Management

Dominant uses: Most of the acreage is used as pasture or range.

Cropland and pasture

Management consideration: The Wortman soil is poorly suited to cropland, and the Wanblee soil is unsuited.

Management concerns: The sodium-affected subsoil, which adversely affects plant growth by restricting root penetration, a slow rate of water infiltration, and the limited available water capacity

Management measures:
• Properly timing tillage, minimizing tillage, and leaving crop residue on the surface conserve moisture.
• Crop rotations that include grasses and legumes help to maintain the content of organic matter and tilth.
• Chiseling or subsoiling improves tilth and increases the rate of water infiltration.
• Proper grazing management helps to maintain plant vigor and conserves moisture.

Interpretive Groups

Land capability classification: Wortman—IVs-2; Wanblee—VIs-1

Range site: Wortman—Claypan; Wanblee—Thin Claypan

Windbreak suitability group: Wortman—9; Wanblee—10

Pasture suitability group: Wortman—C; Wanblee—NS

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded or ponded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

About 1,000 acres in the county, or less than 1 percent of the total acreage, meets the soil requirements for prime farmland. This land is in the northern part of the county, near Milesville. It is in association 3, which is described under the heading "General Soil Map Units." All of this prime farmland is used for crops, mainly corn and winter wheat.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Soils that receive an inadequate amount of rainfall qualify for prime farmland only in areas where this limitation has been overcome by irrigation. The need for irrigation is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

The soils in the county are assigned to various interpretive groups at the end of each map unit description. The groups for each map unit also are shown under the heading "Interpretive Groups," which follows the tables at the back of this survey.

Crops, Pasture, and Hayland

General management needed on the cropland, pasture, and hayland in Haakon County is suggested in this section. The crops best suited to the soils in the survey area are identified. The estimated yields of the main crops are listed for each soil, and the system of land capability classification used by the Natural Resources Conservation Service is explained.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the South Dakota Cooperative Extension Service.

Crops

Jeffrey Hemenway, conservation agronomist, Natural Resources Conservation Service, helped prepare this section.

About 23 percent of the acreage in Haakon County is used for cultivated crops *(5)*. The major crops are winter wheat, grain sorghum, forage sorghum, spring wheat, oats, and alfalfa. Barley, corn, and sunflowers also are grown. Winter wheat, grain sorghum, spring wheat, and sunflowers are grown as cash crops. Oats, barley, and corn are grown as cash crops and as livestock feed. Alfalfa and forage sorghum are harvested mainly for hay.

Kirley, Nimbro, Ottumwa, Promise, Ree, Savo, and other very deep or deep, well drained soils are suited to all of the crops commonly grown in the county. Because of a limited available water capacity, moderately deep soils, such as Lakoma, Opal, and Pierre soils, are better suited to early maturing small grain than to the deeper rooted crops, such as sorghum and alfalfa. The erodible Bankard and Craft soils are better suited to small grain and alfalfa than to row crops because the small grain and alfalfa provide better protection against wind erosion.

The soils in the Haakon county have good potential for increased crop production. Crop production could be increased considerably by extending the latest crop production technology to all of the cropland in the county.

This soil survey can greatly facilitate the application of such technology. The paragraphs that follow describe the management needed on the cropland in the county.

Water erosion reduces productivity and results in sedimentation. It is a hazard on Lakoma, Opal, Ottumwa, Pierre, Promise, and other soils that have a slope of more than 2 percent. Productivity is reduced when the more fertile surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a thin surface layer, such as Vivian soils. When erosion occurs, sediment rich in nutrients enters streams, stock dams, lakes, and reservoirs. Measures that control erosion minimize this pollution and preserve water quality for livestock, fish, and wildlife and for recreational uses. These measures also reduce the amount of fertilizer and pesticides needed on cropland by preventing the removal of plant nutrients and applied pesticides.

A conservation cropping system keeps a plant cover on the surface for extended periods and holds soil losses to an amount that does not reduce the productive capacity of the soils. During periods in the growing season when the crop canopy does not protect the soil, careful management of crop residue is essential. Minimizing tillage and leaving crop residue on the surface increase the rate of water infiltration, reduce the runoff rate, and help to control erosion. Conservation tillage is a form of noninversion tillage that retains protective amounts of crop residue on the surface throughout the year. It is effective in reducing the hazards of both wind erosion and water erosion. Conservation tillage includes no-till, strip-till, mulch-till, ridge-till, and chemical fallow systems in which the number of tillage operations is minimal. Crop residue left standing over winter traps and holds snow and thus permits greater recharge in the soil.

Terraces and diversions help to control erosion by reducing the runoff rate and the length of slopes. They are most practical on very deep and deep, well drained soils that have long, smooth slopes, such as Ottumwa and Promise soils. Many of the soils in Haakon County, however, are poorly suited to terraces and diversions because of short, irregular slopes. In some soils, such as Arvada, Bullcreek, Capa, Hisle, Mosher, Wanblee, and Wortman soils, an unfavorable subsoil would be exposed in terrace channels. Gully erosion in areas of concentrated flow can be effectively controlled by grassed waterways.

The hazard of wind erosion is slight to severe on the soils in the county. The hazard is especially severe on soils having a surface layer of loamy sand, such as Bankard soils. Soils that have a high content of clay in the surface layer, such as Bullcreek, Opal, Ottumwa, Pierre, and Promise soils, also are susceptible to wind erosion. Soils that have a high content of lime in the surface layer, such as Albaton, Bullcreek, Egas, Haverson, Midway, Okaton, Opal, Pierre, Samsil, Sansarc, and Vivian soils, are highly susceptible. Wind erosion can damage these soils in a few hours if winds are strong and the soils are dry and are not protected by a plant canopy or crop residue. Wind erosion can be controlled by an adequate plant cover, crop residue, stripcropping, and tillage methods that keep the surface rough. Windbreaks of suitable trees and shrubs and strips of unharvested crops are also effective in controlling wind erosion.

Information about measures that control erosion on the various soil types in the county is contained in the South Dakota Technical Guide, available in the local office of the Natural Resources Conservation Service or the South Dakota Agricultural Experiment Station at South Dakota State University.

Knowledge of soil fertility levels can help in ascertaining the yields that can be obtained from the soil. A good nutrient management program can provide the nutrients needed by a given crop and thus can optimize yields. The kinds and amounts of fertilizer needed on soils that have a high content of lime in the surface layer, such as Lakoma and Lohmiller soils, generally differ from the kinds and amounts needed on soils that do not have lime in the surface layer.

The nutrient management plan should be based on the kind of soil, the supply of available moisture, the crop to be planted, a realistic yield goal, current soil fertility test levels, whether or not legumes have been planted or agricultural waste has been applied in the past 2 years, and the susceptibility of surface and ground water to nutrient pollution from the site. The plan should be developed annually. It should indicate the kinds and amounts of nutrients needed, the field location, and the time and method of application. The Natural Resources Conservation Service, the South Dakota Cooperative Extension Service, and the South Dakota Agricultural Experiment Station at South Dakota State University can help in developing a nutrient management plan.

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils with good tilth are granular and porous. Management can affect the tilth of a specific soil. In areas where management promotes good tilth, the rate of water infiltration and the available water capacity are increased and seedling emergence and root development are improved. As a result, yields are higher than those in a poorly managed area of the same soil. Improving tilth also reduces the amount of horsepower needed for tillage.

Soil compaction is an important management concern. It occurs when any weight on the soil pushes the soil particles together. If the surface layer or subsoil is compacted, aeration is impaired and it is more difficult for roots to push through the soil and obtain water. The

factors that affect compaction include wetness and clayey textures in the surface layer and subsoil.

Good management can improve tilth and minimize compaction. This management includes growing high-residue crops in the crop rotation a high percentage of the time, deferring grazing and equipment use during wet periods, leaving as much crop residue as possible on or near the surface, and reducing the number of tillage passes required in a field. The timing of farming operations is critical. Compacted areas can be improved by ripping or deep plowing. Tilth and compaction are especially important management concerns on clayey soils, such as Bullcreek, Opal, and Promise soils, and on sodium-affected soils that have a claypan, such as Capa and Mosher soils.

Sodium-affected soils are characterized by a slow rate of water infiltration, are less productive than other soils because of a lower content of organic matter, and restrict root and water penetration because of a dense, compact subsoil. Properly timing tillage, minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the crop rotation help to maintain tilth, fertility, and the content of organic matter in these soils. Chiseling and subsoiling when the soils are dry increase the rate of water infiltration.

Pasture and Hayland

David W. Schmidt, range conservationist, Natural Resources Conservation Service, helped prepare this section.

Pasture and hayland are areas used for the production of adapted domestic perennial forage plants to be grazed by livestock or harvested for hay. These forage plants can be either native or introduced species and can be seeded alone or in a mixture. Generally, they are established as part of a long-term forage program but may established as part of a short-term crop rotation.

Currently, about 9 percent of the county is classified as pasture or hayland *(5)*. The pasture and hayland supply a major portion of the forage for livestock in the county. They include areas that once supported native vegetation but have been invaded by introduced tame grasses, such as smooth bromegrass, because of overgrazing. Managing many of these sites as native rangeland is no longer practical. Many areas of pasture and hayland in the county are producing well below their potential because of overgrazing, improper hayland management, and poor agronomic practices.

Proper pasture and hayland management techniques help to ensure maximum sustained yields. Proper stocking rates allow the pasture plants to remain vigorous. Pastures that are overgrazed lose vigor because of depleted root systems. If overuse is continuous, the plants eventually die and are replaced by less desirable species and by weeds.

Planned grazing systems that include adequate rest periods for the key pasture species improve plant vigor and increase forage production. Rest periods between periods of grazing allow the pasture plants to regrow and replenish their energy reserves. Haying at the proper stage of plant growth helps to maintain plant vigor. Generally, the plants should be cut for hay at the early or mid bloom stage.

Grazing pasture species at the proper stage of growth improves plant vigor and increases forage production. Grazing a plant before it has produced enough leaf material to replenish stored energy reserves reduces plant vigor and forage production. Generally, the plants should be allowed to grow to a height of 8 to 14 inches before they are grazed, depending on the species being managed. Allowing the plants to become too tall or mature before the initiation of grazing reduces the quality of the forage and somewhat reduces the quantity.

Allowing the plants to regrow before the first killing frost permits the plants to store enough energy reserves to survive the winter and initiate growth during the following spring. Forage production during the following year will improve. In addition, the regrowth will trap snow and thus increase the supply of soil moisture.

Matching plant species to the season of use is important. Pasture and hayland species can be divided into two broad categories—cool-season species and warm-season species. Cool-season species begin to grow in early spring and end growth in early summer. If adequate soil moisture is available, they may regrow again when temperatures cool in the fall. Warm-season species begin to grow in early summer. They produce the majority of their forage during the hot summer months. Examples of cool-season species are smooth bromegrass, intermediate wheatgrass, and alfalfa. Examples of warm-season species are big bluestem and switchgrass. The warm-season species provide nutritious forage for livestock during July and August. If a cool-season species is utilized during this period, reduced livestock performance will be the result.

In order to maintain optimum forage production, occasional renovation of pasture and hayland is needed. The amount of time that pasture and hayland remain productive depends on the plant species, the kind of soil, climatic factors, and management. Many of the tame species should be replaced once every 5 to 10 years. Native species, which are adapted to the site, generally remain productive for an extended period. The length of the productive period is highly dependent on the pasture and hayland management techniques that are used. The species selected for planting should be those that are suited to the soils and that meet the needs of the

producer. Selecting improved varieties commonly increases forage production, improves the quality of the forage, helps to establish the stand, and increases the longevity of the stand.

Maintaining the fertility of the soil is imperative in managing pasture and hayland. Basing the kinds and amounts of fertilizer to be applied on the results of soil tests reduces the threat of water contamination and assures economic feasibility. Applying the proper kinds and amounts of fertilizer increases forage production, increases the longevity of the stand, and improves the quality of the forage. When planted with grasses, legumes, such as alfalfa, commonly provide sufficient nitrogen to meet the needs of the grass species.

Weeds can often become a problem on pasture and hayland, mainly because of poor management. Overgrazing, poor fertility, and selection of species that are not suited to the site increase the extent of weeds. The weeds should be controlled within economical and environmental constraints.

The soils are assigned to pasture suitability groups at the end of each description under the heading "Detailed Soil Map Units" and in the section "Interpretive Groups," which follows tables in the back of this survey. The principal criteria used in assigning the soils to these groups are depth, drainage, texture, structure, permeability, available water capacity, landform position, and special internal features. The groups are described in the paragraphs that follow. The description of each group indicates the major hazards and limitations affecting the use of the soils in the group for hay and pasture. It also lists the forage species best suited to the group. The species listed were selected for their yield potential, their suitability to the site, their palatability, and the relative ease with which they can be established.

The soils in the county are assigned to nine different pasture suitability groups. The symbols for these groups are B2, C, D1, F, H, I, J, K, and NS.

Group B2. These soils receive additional moisture because of runoff. Excess moisture limits the choice of climatically adapted grasses to water-tolerant species.

The soils in this group are not artificially drained. Examples are Albaton, Hoven, and Kolls soils. The species best suited to these soils include western wheatgrass. The major management concern is the soil compaction caused by haying or grazing when the soils are saturated. Timely deferment of grazing and haying can minimize compaction and improve plant vigor.

Group C. These soils have a claypan subsoil that is slowly permeable or very slowly permeable. The underlying material and the lower part of the subsoil typically have a high content of soluble salts. An unfavorable root zone limits the choice and productivity of climatically adapted grasses and legumes.

The soils in this group generally are very deep to moderately deep and are well drained to somewhat poorly drained. They have a silty or loamy surface layer about 5 to 10 inches thick. Examples are Mosher and Wortman soils. The species best suited to these soils include alfalfa, crested wheatgrass, green needlegrass, intermediate wheatgrass, pubescent wheatgrass, and western wheatgrass. The major management concerns are the accumulations of excess salt, soil compaction, and the inherent droughtiness of the site. Proper hayland management and proper grazing use, including deferred grazing programs, help to maintain a healthy plant community and minimize soil-related management problems.

Group D1. These soils have a moderately deep root zone and a less than optimum available water capacity, both of which limit the choice of climatically adapted grasses.

The soils in this group are excessively drained to somewhat poorly drained and are moderately deep over sand and gravel. An example is Canning soils. The species best suited to these soils include alfalfa, intermediate wheatgrass, pubescent wheatgrass, and western wheatgrass. The major management concern is maintaining plant vigor. Proper hayland management and proper grazing use, including deferred grazing or a planned grazing system, help to maintain plant vigor.

Group F. These soils generally are very deep to moderately deep, are well drained, and are silty. Some of the soils are subject to rare flooding, are calcareous, or have a short-duration water table. All climatically adapted grasses and legumes are suitable, but bunch grasses should not be grown in areas where the slope is 6 percent or more.

Blackpipe, Craft, Haverson, Kirley, Lohmiller, Nimbro, Nunn, Ree, and Savo are examples of the soils in this group. The species best suited to these soils include alfalfa, crested wheatgrass, green needlegrass, intermediate wheatgrass, pubescent wheatgrass, and western wheatgrass. The major management concern is maintaining plant vigor and soil tilth. Proper grazing use, deferred grazing, planned grazing systems, and proper hayland management can improve plant vigor and maintain soil tilth. Applications of fertilizer that meet plant nutrient needs increase plant vigor and forage production.

Group H. These soils are moderately rapidly permeable or rapidly permeable and have a low or moderate available water capacity. The hazard of erosion

and the available water capacity limit the choice and productivity of climatically adapted grasses and legumes.

Bankard very fine sandy loam is a typical soil in this group. The species best suited to this soil include alfalfa, crested wheatgrass, intermediate wheatgrass, pubescent wheatgrass, big bluestem, sand bluestem, indiangrass, and switchgrass. The major management concerns are maintaining plant vigor and reducing the hazard of erosion. Proper grazing use, deferred grazing, planned grazing systems, and proper hayland management improve plant vigor and help to control erosion.

Group I. These soils have a very slow rate of water infiltration. An unfavorable root zone and the very slow rate of water infiltration limit the choice and productivity of climatically adapted grasses and legumes.

Hilmoe, Kyle, Lakoma, Opal, Ottumwa, Pierre, Promise, Razor, and Wendte are examples of the soils in this group. The species best suited to these soils include alfalfa, crested wheatgrass, green needlegrass, intermediate wheatgrass, pubescent wheatgrass, and western wheatgrass. The major management concern is maintaining plant vigor and soil tilth. Haying or grazing when the soils are saturated can result in compaction. Proper grazing use, deferred grazing, planned grazing systems, and proper hayland management can improve plant vigor and soil tilth.

Group J. These soils are moderately or strongly saline or alkaline and have a long-duration water table. The salinity and alkalinity severely limit the choice and productivity of climatically adapted grasses and legumes.

The soils in this group generally are very deep and are poorly drained or very poorly drained. An example is Egas soils. The species best suited to these soils include tall wheatgrass and western wheatgrass. The major management concern is maintaining the desirable plant community on these salt-affected soils. Haying or grazing when the soils are saturated can result in compaction. Proper grazing use, deferred grazing, planned grazing systems, and proper hayland management can help to maintain plant vigor and ensure survival of the stand.

Group K. These soils receive additional moisture because of runoff. They have a thick, dark surface layer. All climatically adapted grasses and legumes are suitable.

The soils in this group generally are very deep and are well drained or moderately well drained. As example is Onita soils. The species best suited to these soils include alfalfa, green needlegrass, intermediate wheatgrass, smooth bromegrass, big bluestem, indiangrass, switchgrass, and western wheatgrass. The major management concern is maintaining plant vigor and soil tilth. Proper grazing use, deferred grazing, planned grazing systems, and proper hayland management can improve plant vigor and soil tilth.

Group NS. These soils are very shallow to gravel, are sandy and have a low content of organic matter, are very strongly saline or alkaline, are dissected by meandering channels, or are clayey and have a dense subsoil. This group also includes steeply sloping soils that are not suitable for pasture because of the hazard of erosion and the difficulty in establishing erosion-control practices and pasture plants. Because of severe limitations, this group is not recommended for pasture.

The soils in this group generally are shallow to very deep. Examples are Arvada, Bankard, Bullcreek, Capa, Hisle, Midway, Nihill, Okaton, Samsil, Sansarc, Schamber, Shingle, Vivian, and Wanblee soils; steeply sloping phases of Lakoma, Pierre, and Razor soils; and channeled phases of Haverson, Lohmiller, Nimbro, and Wendte soils.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, extension agents, and research scientists. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include a cropping sequence that makes efficient use of the available moisture, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; measures that minimize compaction; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and other essential elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service, the

South Dakota Cooperative Extension Service, or the South Dakota Agricultural Experiment Station at South Dakota State University can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for pasture and hayland, for rangeland, for woodland, or for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit *(9)*. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations or hazards that restrict their use.

Class II soils have moderate limitations or hazards that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations or hazards that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations or hazards that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations or hazards, impractical to remove, that limit their use.

Class VI soils have severe limitations or hazards that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations or hazards that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations or hazards that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 and IIIe-4.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the section "Interpretive Groups," which follows the tables at the back of this survey.

Rangeland

Leon "Mike" Stirling, resource conservationist, Natural Resources Conservation Service, helped prepare this section.

Rangeland is land on which the natural potential plant community consists of grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes areas that are revegetated naturally or artificially and are managed like rangeland. The amount and kind of native vegetation growing in any one area are influenced by the kind of soil, topography, climate, past use, and management.

Prior to the influence of European settlers, most of the acreage in the county was rangeland. The rest consisted of narrow stringers of trees and woody vegetation along rivers and drainageways and on steep breaks. Currently, about 65 percent of the county is rangeland *(5)*. The rangeland supplies a major portion of the forage and feed for livestock in the county.

Most of the ranches in the county are cow-calf operations. Some are strictly yearling operations, and several are a combination of cow-calf and yearling operations. The combination provides greater flexibility in matching the demand for forage with a widely fluctuating, rainfall-dependent forage supply. The county has limited numbers of sheep.

The rangeland generally is grazed from May to December. The forage provided by rangeland is supplemented by crop aftermath and tame pasture plants, such as intermediate wheatgrass, crested wheatgrass,

and alfalfa. In winter most ranchers feed hay to their livestock, but some ranchers provide protein supplements and allow beef cattle and horses to graze through the winter months.

Haakon County is in the mixed grass prairie region. The native vegetation is dominated by mid grasses, such as western wheatgrass, and forbs, such as fringed sagewort. Short grasses, such as blue grama and buffalograss, are interspersed with the mid grasses. In some areas tall grasses, such as big bluestem and prairie cordgrass, are common. The mixed grass prairie consists of cool- and warm-season plants that provide good-quality forage throughout the grazing season. The cool-season plants, such as western wheatgrass and pasqueflower, actively grow and mature during April, May, and June. The warm-season plants, such as big bluestem and dotted gayfeather, grow and mature during June, July, and August.

The potential production of native vegetation has been reduced in some parts of the county because of past overuse by livestock. The taller and more palatable grasses, forbs, and shrubs have become less productive and less abundant. They have been replaced by plants that are less sensitive to livestock grazing. The tall and mid grasses have been replaced by Japanese brome, blue grama, buffalograss, and fringed sagewort. Woody plants that typically grow in areas along creek channels and on steep slopes have been reduced in abundance or eliminated because of browsing or trampling by livestock. Most of these areas, however, have remnants of the desirable plants. Through improved grazing management, ranchers are reestablishing the high-quality natural potential plant community that the sites are capable of supporting.

Range Sites and Condition Classes

A range site is an area of rangeland that has the potential to produce and sustain a distinctive native plant community. The kinds and amounts of native plants on a particular range site differ from those on other range sites. The potential native plant community on each range site is the result of a unique combination of environmental factors, particularly climate and soils.

Within climatic zones, soil differences account for variations in the potential plant community on a range site. Therefore, soils are synonymous with range sites. The soil properties that affect the supply of moisture and plant nutrients have the greatest influence on the plant community. Soil reaction, texture, salt content, and rooting depth also are important. Soils that produce approximately the same kinds, amounts, and proportions of native plants make up a range site. The potential plant community on a range site is the most stable plant community that the site is capable of producing. This plant community maintains itself and changes very little as long as the environment remains unchanged. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil maps.

The plants within the native plant community can be grouped as decreasers, increasers, or invaders, depending on their response to grazing pressure. Decreasers are plants that respond to overgrazing by decreasing in abundance. They generally are the taller, more productive plants and are the ones that are most preferred by grazing animals. Increasers are plants that respond to grazing pressure by increasing, at least initially, in amount as the more preferred decreaser plants become less abundant. Increasers are generally less productive and less nutritious than decreasers. Invaders are plants that are not part of the original plant community but invade the range site after periods of continued overgrazing or some other kind of disturbance of the ecosystem. Most invader plants have little or no grazing value. Some of these plants, however, have value as forage. Examples are smooth bromegrass and crested wheatgrass.

Because plants do not respond in the same manner to different influences, a plant may be a decreaser on some range sites but an increaser on others. A cool-season plant, for example, may be a decreaser if the site is grazed only during the cool spring months but would be an increaser if the same site were grazed only during the warm summer months. The reverse would be true for the warm-season plants. Restricting grazing to the spring would cause the warm-season plants to increase in abundance, and restricting grazing to the summer would cause them to decrease.

Table 7 shows, for each soil suitable for rangeland in the county, the range site; the potential annual production of vegetation in favorable, average, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only the soils that are suitable for use as rangeland are listed. *Potential annual production* is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to livestock. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture. Clipping data has shown that

annual production during unfavorable years can be as low as 25 percent of normal.

Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure and rainfall.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition, which is an ecological rating of a range site. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition.

The objective in range management is to control grazing so that the plants growing on a site are similar in kind and amount to the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Recognizing changes in the plant community that are contrary to the health of the range site and to management objectives and responding to those changes are important challenges for range managers. Monitoring the range condition and trend is an important component of good range management. Monitoring information can help managers to evaluate the effects of management on the range resource and can enable them to make timely adjustments when needed.

Four range condition classes are recognized. The range site is in *excellent* condition if 76 to 100 percent of the present vegetation is the same kind as the potential native vegetation, in *good* condition if the percentage is 51 to 75, in *fair* condition if the percentage is 26 to 50, and in *poor* condition if the percentage is 25 or less. The potential production depends on the range site, the range condition, and the moisture available to plants during the growing season.

Measures that maintain or improve the range condition are needed on all of the rangeland in the county. They include proper stocking rates and rotation or deferred rotation grazing systems. These systems provide rest periods that maintain or improve the vigor of the key plants. Good range management also includes range seeding, fencing, and measures that provide water for livestock.

The soils in the county are assigned to various range sites. The names of these sites are Clayey, Clayey Overflow, Claypan, Closed Depression, Dense Clay, Loamy Overflow, Loamy Terrace, Saline Lowland, Sands, Sandy, Shallow, Shallow Clay, Silty, Thin Claypan, Thin Upland, Very Shallow, and Wetland. The paragraphs that follow describe these range sites.

Clayey range site. The soils assigned to this range site have a clayey subsoil within a depth of 14 inches. The clayey subsoil releases moisture slowly to plants and somewhat restricts the development of plant roots.

The potential native vegetation is a prairie of mid and short grasses interspersed with a variety of forbs. Western wheatgrass and green needlegrass, which are cool-season grasses, make up about 70 percent of the vegetation. Grasslike sedges make up about 5 percent. Sideoats grama, blue grama, and buffalograss, which are warm-season grasses, make up about 20 percent. Forbs, such as western yarrow, fringed sagewort, cudweed sagewort, sweetclover, and scarlet globemallow, make up the remainder of the vegetation.

The major management concern on this site is maintaining the amount of the most productive grasses. Green needlegrass and sideoats grama rapidly lose their productive capacity after continued overgrazing because livestock prefer these species. Western wheatgrass initially increases in amount after overuse. If overuse continues, however, it decreases in amount and loses vigor. Blue grama, buffalograss, and sedges increase in amount as the taller grasses decrease. The result is a less productive short-grass plant community and increased runoff. The amount of the most productive grasses can be increased or maintained by proper stocking rates and a rotation grazing or deferred grazing program that provides periodic rest periods during the growing season of the plants. Limiting grazing during wet periods minimizes soil compaction.

Clayey Overflow range site. The soils assigned to this range site regularly benefit from more than normal soil moisture because of stream overflow or runoff from the higher adjacent areas. The surface layer and subsoil of these soils are silty clay or clay.

The potential native vegetation on this site is mid prairie grasses. Western wheatgrass and green needlegrass, which are cool-season grasses, make up about 75 percent of the plant community. Warm-season, short grasses, such as blue grama and buffalograss, make up about 10 percent. Forbs, shrubs, and trees make up the remainder of the vegetation. In some areas that are fed by springs or seeps, prairie cordgrass is a major component in the plant community. The taller shrubs and trees, such as plum, chokecherry, buffaloberry, green ash, and cottonwood, commonly grow on this site.

The major management concern on this site is

maintaining the amount of the most productive grasses and a plant cover that helps to prevent gully erosion. Green needlegrass rapidly decreases in amount after continued overgrazing because livestock prefer this species. Western wheatgrass initially increases in amount as green needlegrass decreases. If overgrazing continues, blue grama and buffalograss become the dominant grasses on the site. Lower forage production is the result. In severely overgrazed areas, the amount of bare soil increases, leaving the site susceptible to gully erosion. The amount of the most productive grasses can be increased or maintained by proper stocking rates and deferment of grazing during the critical growth stages of the key cool-season grasses. Limiting grazing during wet periods minimizes soil compaction.

Claypan range site. The soils assigned to this range site have a sodium-affected subsoil. Salt accumulations generally are in the lower part of the subsoil, below a depth of 16 inches.

The potential native vegetation is a prairie of mid and short grasses interspersed with some forbs. Western wheatgrass, green needlegrass, and needleandthread, which are cool-season grasses, make up about 65 percent of the vegetation. Blue grama and buffalograss, which are warm-season grasses, make up about 20 percent. Of these two grasses, blue grama is dominant. Grasslike sedges and forbs make up about 10 percent of the vegetation. The shrub species silver sagebrush and pricklypear make up about 5 percent.

The major management concern on this site is maintaining the amount of the most productive grasses. Green needlegrass and western wheatgrass rapidly decrease in amount and lose vigor after continued overgrazing because livestock prefer these plants. Blue grama, buffalograss, sedges, and pricklypear increase in amount as the other grasses decrease. The result is less forage production. The amount of the most productive grasses can be increased or maintained by proper stocking rates and a rotation grazing or deferred grazing program that provides periodic rest periods during the growing season of the plants. Soil compaction is a potential problem during wet periods.

Closed Depression range site. The soils assigned to this range site are on the flat or concave bottom of closed depressions. They may be excessively wet or ponded for short periods during years of above average precipitation and droughty during abnormally dry periods.

The potential vegetation is dominated by western wheatgrass, which makes up about 85 percent of the plant community. Sedges make up about 10 percent of the vegetation, and forbs make up about 5 percent. The plant community is not stable because of the wet and dry cycles.

The major management concern on this site is maintaining the amount of the most desirable plant community. Continued overgrazing reduces the production of western wheatgrass, and trampling by livestock aggravates the poor drainage characteristics of the site. Saltgrass and curled dock increase in amount and foxtail barley invades as western wheatgrass decreases in amount. The result is a less productive site. The amount of the most productive grasses can be increased or maintained by proper stocking rates and timely deferment of grazing, particularly when the soil surface is saturated and the plants are subject to trampling damage. Limiting grazing during wet periods minimizes soil compaction.

Dense Clay range site. The soils assigned to this range site are shallow to very deep and have a weak or nearly structureless surface layer of clay underlain at a depth of 14 inches or less by dense, weak-structured clay or altered shale. The soils are on uplands.

The potential native vegetation is a prairie of mid grasses interspersed with forbs. Western wheatgrass makes up about 70 percent of the vegetation, and green needlegrass makes up about 20 percent. Both of these are cool-season plants. Forbs, such as wild onion and wild parsley, and shrubs, such as pricklypear and silver sagebrush, make up about 10 percent of the vegetation. This site is in the same landscape positions as the Clayey range site but lacks an understory of short grasses.

The major management concern on this site is keeping the western wheatgrass and green needlegrass productive. After continued overgrazing, these two grasses thin out and are replaced by increasers, such as pricklypear, and invaders, such as annual brome. In extremely overgrazed areas, the site becomes bare of vegetation and highly susceptible to erosion. The amount of green needlegrass and western wheatgrass can be increased or maintained by proper stocking rates and a deferred grazing or rotation grazing program that provides periodic rest periods during the late spring and early summer growing seasons of these key grasses. Limiting grazing during wet periods minimizes soil compaction.

Loamy Overflow range site. The soils assigned to this range site regularly benefit from more than normal soil moisture because of stream overflow or runoff from the higher adjacent areas. The surface layer and subsoil of these soils are sandy loam to silty clay.

The potential native vegetation is a mixture of tall and mid grasses. Warm-season grasses, such as big bluestem, switchgrass, indiangrass, and little bluestem, make up 60 percent of the vegetation. Green needlegrass, western wheatgrass, and bluegrass, which

are cool-season grasses, make up 25 percent. Forbs, such as western yarrow and American licorice, and shrubs, such as leadplant, western snowberry, and wildrose, make up about 10 percent. The taller shrubs and trees, such as chokecherry, buffaloberry, bur oak, green ash, cottonwood, and hackberry, commonly grow on this site.

The major management concern on this site is maintaining the amount of the most productive grasses. Big bluestem, switchgrass, green needlegrass, and little bluestem rapidly lose their productive capacity and thin out after continued overgrazing because livestock prefer these plants. Western wheatgrass initially increases in amount as these grasses decrease. If overgrazing continues, Kentucky bluegrass, a short, cool-season grass, becomes the principal plant on the site. The result is low forage production. The amount of the most productive grasses can be increased or maintained by proper stocking rates and a deferred grazing or rotation grazing program that provides periodic rest periods during the key growing season of the plants.

Loamy Terrace range site. The soils assigned to this range site are alluvial. They have a texture of silt loam to fine sandy loam. They may receive some runoff from the adjacent areas, but they do not receive beneficial stream overflow.

The potential native vegetation on this site is a mixture of mid and tall grasses. Western wheatgrass, green needlegrass, and needleandthread, which are cool-season grasses, make up about 70 percent of the vegetation. Big bluestem, little bluestem, prairie sandreed, and blue grama, which are warm-season grasses, make up about 20 percent. Forbs, such as fringed sagewort, and shrubs, such as western snowberry, make up the remainder of the vegetation.

The major management concern on this site is maintaining the amount of the most productive grasses. After continued overgrazing, the amount of western wheatgrass, green needlegrass, needleandthread, and prairie sandreed decreases and the amount of buffalograss, blue grama, forbs, and woody plants increases. The amount of the most productive grasses can be increased or maintained by proper stocking rates and by timely deferment of grazing or rotation grazing.

Saline Lowland range site. The soils assigned to this range site are poorly drained and have a concentration of soluble salts, which affect the kind and amount of vegetation. The soils are too saline for big bluestem. They have a texture of loam to clay.

The normal potential vegetation consists of species that are tolerant of salinity. Western wheatgrass and Nuttall alkaligrass, which are cool-season grasses, make up about 60 percent of the vegetation. In areas where the soils have a high water table, prairie cordgrass can make up as much as 60 percent of the vegetation. The rest of the grasses that grow on this site are alkali sacaton, saltgrass, and foxtail barley. Forbs, such as annual saltbush, sumpweed, and seepweed, and shrubs, such as greasewood and Nuttall saltbush, make up the remainder of the vegetation.

The major management concern on this site is maintaining the amount of the most productive grasses and a plant cover that helps to prevent gully erosion. Western wheatgrass and prairie cordgrass are strongly rhizomatous and protect the site from erosion. Heavy use early in the growing season can cause these grasses to decrease in abundance. The result is an increase in the amount of the less productive grasses, such as saltgrass, blue grama, bluegrasses, and foxtail barley. If overuse continues, saltgrass becomes the principal grass on the site. The amount of the most productive grasses can be increased or maintained by proper stocking rates, deferment of grazing during the critical early growing season, or a rotation grazing program that provides periodic rest periods during the key growing season of the plants.

Sands range site. The soils assigned to this range site are very deep, loose, and somewhat excessively drained. They have a texture of loamy fine sand to fine sand. They take in water rapidly and lose little of the water through runoff. They have a limited available water capacity, which reduces forage production. Wind erosion is a serious problem unless a stable plant cover is maintained.

The potential native vegetation is mixed tall and mid prairie grasses. Warm-season grasses, such as prairie sandreed, little bluestem, big bluestem, and sand bluestem, make up about 70 percent of the vegetation. Switchgrass, indiangrass, needleandthread, and blue grama make up about 20 percent. Forbs and shrubs, such as leadplant, wild rose, and sand cherry, make up the remainder of the vegetation.

The major management concern on this site is maintaining the amount of the most productive tall grasses. After continued overgrazing, the bluestems, prairie sandreed, and switchgrass are replaced by sand dropseed and blue grama. If overgrazing continues, the amount of green sagewort and sandbur increases and the surface is bare in spots. The bare areas are highly susceptible to wind erosion. The amount of the most productive grasses can be increased or maintained by proper stocking rates and by timely deferment of grazing or rotation grazing.

Sandy range site. The soils assigned to this range site are very deep and well drained and have a surface layer

of sandy loam or very fine sandy loam and a subsoil of sandy loam to sand.

The potential native vegetation on this site is mixed prairie grasses, chiefly mid and tall grasses. Warm-season grasses, such as little bluestem and sand bluestem are dominant. Cool-season grasses, such as needleandthread and western wheatgrass, are important. Sideoats grama and sedges make up the understory vegetation. Forbs, such as scurfpea and sagewort, are common but are in small amounts.

The major management concern on this site is maintaining the amount of the most productive grasses. After continuous overgrazing, the amount of bluestems decreases and the amount of prairie sandreed, needleandthread, and western wheatgrass increases. If overgrazing continues, these grasses thin out and are replaced by sand dropseed, blue grama, threadleaf sedge, sagewort, and Kentucky bluegrass. Low forage production is the result. The amount of the most productive grasses can be increased or maintained by proper stocking rates and by timely deferment of grazing or rotation grazing.

Shallow range site. The soils assigned to this range site are shallow, have a surface layer of loam to silty clay, and are underlain at a depth of 10 to 20 inches by soft bedrock, which may or may not be consolidated. If the bedrock is consolidated, moisture penetration is inhibited. If unconsolidated, the bedrock greatly reduces the available water capacity.

The normal potential native vegetation is a mixed grass prairie. Little bluestem, sideoats grama, big bluestem, plains muhly, and blue grama, which are warm-season grasses, make up about 70 percent of the vegetation. Cool-season grasses, such as green needlegrass, western wheatgrass, and needleandthread, and sedges make up about 20 percent. Forbs, such as bracted spiderwort, blacksamson, and sageworts, and woody plants, such as leadplant, yucca, skunkbush sumac, buffaloberry, and rose, make up the remainder of the vegetation.

The major management concern on this site is maintaining the amount of the most productive grasses. After continued overgrazing, little bluestem, big bluestem, green needlegrass, and plains muhly decrease in amount because livestock prefer these grasses. Western wheatgrass, sideoats grama, and needleandthread initially increase in amount after overuse. If overuse continues, however, they decrease in amount and are replaced by short grasses, such as blue grama. The result is low forage production. The amount of the most productive grasses can be increased or maintained by proper stocking rates and a deferred grazing or rotation grazing program that provides periodic rest periods during the key growing season of the plants.

Shallow Clay range site. The soils assigned to this range site are shallow, have a surface layer of clay, and are underlain by relatively impervious shale or mudstone at a depth of 10 to 20 inches.

The potential native vegetation on this site is mixed prairie grasses. Little bluestem, big bluestem, sideoats grama, and blue grama, which are warm-season grasses, make up about 45 percent of the vegetation. Cool-season grasses, such as western wheatgrass and green needlegrass, make up about 40 percent. Sedges, shrubs, and forbs make up the remainder of the vegetation.

In some areas where the bedded shale is within 10 to 12 inches of the surface and little soil development has occurred, the plant community is similar to that on the Sands range site and is dominated by big bluestem and little bluestem. Sideoats grama and prairie sandreed also are abundant. With the exception of a minor amount of sedges, cool-season plants do not grow in these areas of bedded shale.

The major management concern on this site is maintaining the amount of the most productive grasses. Little bluestem, big bluestem, and green needlegrass rapidly decrease in amount in overgrazed areas. The amount of western wheatgrass and sideoats grama initially increases in these areas. If overgrazing continues, however, the amount of these grasses decreases and the amount of sedges and bare soil increases. The result is low forage production and increased runoff and erosion. Shale blowouts are in some of the overgrazed areas. The amount of the most productive grasses can be increased or maintained by moderate stocking rates and by timely deferment of grazing during the growing season of the plants. Limiting grazing during wet periods minimizes soil compaction.

Silty range site. The soils assigned to this range site have a surface layer and subsoil of loam to silty clay loam, are well drained and moderately well drained, and have a low to high available water capacity and favorable soil-water-plant relationships.

The potential native vegetation is a mixed grass prairie. Cool-season grasses make up about 65 percent of the vegetation. Green needlegrass and western wheatgrass are the major cool-season grasses along with lesser amounts of needleandthread and porcupinegrass. Warm-season grasses, such as big bluestem, sideoats grama, and blue grama, make up about 20 percent of the vegetation. Forbs, such as sageworts and false boneset, and shrubs, such as leadplant, wild rose, and western snowberry, make up the remainder of the vegetation.

The major management concern on this site is maintaining the amount of the most productive grasses. After continued overgrazing, little bluestem, porcupinegrass, and green needlegrass decrease in amount because livestock prefer these grasses. Western wheatgrass and needleandthread initially increase in amount in overgrazed areas. If overgrazing continues, blue grama becomes the dominant grass; a wide variety of low-value forbs, such as curlycup gumweed, invade; and sageworts increase in amount. The result is low forage production. The amount of the most productive grasses can be increased or maintained by proper stocking rates and a deferred grazing or rotation grazing program that provides periodic rest periods during the key growing season of the plants.

Thin Claypan range site. The soils assigned to this range site have a surface layer of loam to clay and have a sodium-affected subsoil at a depth of less than 4 inches. The subsoil generally does not extend below a depth of 16 inches. Salt accumulations are generally in the lower part of the subsoil.

The potential native vegetation on this site is a mixture of mid and short grasses. Western wheatgrass and needleandthread, which are cool-season grasses, make up about 40 percent of the vegetation. Warm-season, short grasses, such as blue grama and buffalograss, make up about 40 percent. Inland saltgrass and sedges make up about 10 percent. Forbs, such as sageworts, heath aster, and broom snakeweed, make up the remainder of the vegetation.

The major management concern on this site is maintaining the amount of western wheatgrass. After continued overgrazing, western wheatgrass thins out and is replaced by blue grama, buffalograss, pricklypear, and saltgrass. If overgrazing continues, there is a considerable amount of bare ground, especially during dry periods, and weeds are common during wet periods. The amount of western wheatgrass can be increased or maintained by proper stocking rates and a deferred grazing program that provides periodic rest periods during the key growing season. Restricted grazing during wet periods helps to prevent surface compaction, puddling, and physical damage to the vegetation.

Thin Upland range site. The soils assigned to this range site have a thin surface layer that formed in calcareous material. The surface layer is sandy loam to silty clay loam. The relatively unweathered parent material is strongly calcareous, generally soft, and very friable.

The potential native vegetation is a mixed stand of mid and tall grasses. Little bluestem, big bluestem, sideoats grama, blue grama, and prairie sandreed, which are warm-season grasses, make up about 60 percent of the vegetation. Cool-season grasses, such as porcupinegrass, green needlegrass, needleandthread, and western wheatgrass, make up about 20 percent. Needleleaf and threadleaf sedges make up about 10 percent. Forbs, such as blacksamson, groundplum milkvetch, and sageworts, and shrubs, such as wild rose, leadplant, dwarf indigo, skunkbush sumac, buffaloberry, and yucca, make up the remainder of the vegetation.

The major management concern on this site is maintaining the amount of the most productive grasses and the desirable balance of cool- and warm-season plants. In overgrazed areas, the bluestems and needlegrasses lose their vigor and density and western wheatgrass, sideoats grama, and sedges increase in abundance. If overgrazing continues, sedges, blue grama, and unpalatable forbs become abundant. The amount of the most productive grasses can be increased or maintained by proper stocking rates and a rotation grazing or deferred grazing program that provides periodic rest periods during the key growing season of the plants.

Very Shallow range site. The soils assigned to this range site are very shallow, have a surface layer of loam or gravelly loam, and are underlain by sand and gravel within a depth of 10 inches. They are droughty because of moderate to rapid permeability and a low available water capacity.

The potential native vegetation is a mixture of mid and short grasses. Blue grama, little bluestem, and sideoats grama, which are warm-season grasses, make up 45 percent of the vegetation. Needleandthread and western wheatgrass, which are cool-season grasses, and threadleaf sedge make up 45 percent. Forbs, such as fringed sagewort, broom snakeweed, and dotted gayfeather, and shrubs, such as pricklypear, make up the remainder of the vegetation.

The major management concern on this site is maintaining the amount of the most productive grasses. Needleandthread, western wheatgrass, and sideoats grama rapidly lose their productive capacity after continued overuse because livestock prefer these species. Blue grama and sedges increase in amount as the taller grasses decrease. The result is lower forage production. If overuse continues, unpalatable and undesirable plants, such as fringed sagewort, pricklypear, Japanese brome, prairie threeawn, and curlycup gumweed, increase in abundance. The amount of the more productive grasses can be increased or maintained by proper stocking rates and a deferred grazing or rotation grazing program that provides periodic rest periods during the key growing season of the plants.

Wetland range site. The soils assigned to this range site have a water table within a depth of 36 inches during

most of the growing season. The water table may rise above the surface in spring but only for short periods. Excess water and the resultant poor drainage of the soils limit the kinds of grass that can grow on this site. The soils are too wet and poorly aerated for big bluestem. They are not saline.

The potential native vegetation is a prairie of water-tolerant, tall grasses, sedges, cattails, and rushes. Prairie cordgrass makes up about 70 percent of the plant community. Switchgrass and Canada wildrye make up about 10 percent. Wetland sedges, cattails, and rushes make up about 10 percent. Forbs, such as smartweed and pale dock, and shrubs, such as indigobush amorpha and willows, make up about 10 percent.

The major management concern on this site is maintaining the amount of the most productive grasses and a plant cover that helps to prevent gully erosion in the drainageways. Prairie cordgrass is strongly rhizomatous and becomes coarse and stemmy as it matures. As a result, it is resistant to overgrazing. It decreases in abundance if it is subject to continued heavy grazing early in the growing season, when it is more palatable. Smartweed, saltgrass, and rushes increase in abundance in overgrazed areas. Continued overgrazing results in dramatic increases in the amount of bare soil, resulting in severe gully erosion and long-term damage to the site. The amount of the most productive grasses can be increased or maintained by proper stocking rates and deferment of grazing during the critical early growth stages of the key warm-season grasses. Soil compaction is a potential problem during wet periods.

Native Woodland, Windbreaks, and Environmental Plantings

Gregory F. Yapp, forester, Natural Resources Conservation Service, helped prepare this section.

Native trees and shrubs grow on about 35,000 acres in Haakon County (fig. 10). Most of the wooded areas are on the low flood plains along the Bad and Cheyenne Rivers. The soils in areas where trees and shrubs grow naturally are not classified as woodland soils. They are grassland soils that formed under the influence of grassland vegetation. The areas where trees and shrubs grow have expanded since presettlement times, largely as a result of the control of prairie fires.

The soils in areas of native trees and shrubs are the channeled Wendte, Lohmiller, and Nimbro soils and Bankard and Craft soils along the Bad and Cheyenne Rivers. The dominant woody species in these areas American elm, green ash, and plains cottonwood. Boxelder, common chokecherry, Virginia creeper, American plum, sandbar willow, peachleaf willow, and western snowberry also grow in these areas.

Schamber and Samsil soils are in areas on uplands where trees and shrubs grow along some of the minor drainageways. These areas are most likely to support trees and shrubs on north aspects and where seeps occur. The most common species are Rocky mountain juniper, green ash, American elm, skunkbush sumac, common chokecherry, American plum, and western snowberry. Plains cottonwood grows on the bottom of the draws where seeps occur.

Windbreaks have been planted since the days of the early settlers. The first plantings were made to protect farmsteads and livestock from wind and snow. Such windbreaks are still needed throughout the county. They generally are planted in several rows around buildings and in livestock areas. Six or more rows of broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and are spaced at specific intervals across the field. Field windbreaks protect cropland and crops from wind and help to keep snow on the fields. They provide food and cover for wildlife. They generally consist of one or two rows of suitable trees. Tree planting is needed to improve water quality in areas adjacent to drainageways.

Environmental plantings help to beautify and screen houses and other buildings. The plants, mostly evergreen shrubs and trees, also help to abate noise.

To maximize plant survival and growth rates, suitable species should be planted properly on a well prepared site. Summer fallowing the year prior to planting helps to build up moisture reserves and control weeds. Good weed control is needed for 3 to 5 years at a minimum to ensure the long-term survival of the windbreak. Cultivation and applications of herbicide are effective in controlling weeds.

Grazing is extremely damaging to windbreaks because livestock compact the soil and remove the lower branches of the trees and shrubs. Removal of the lower branches reduces the effectiveness of the windbreaks.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on the various soil types in the county. The estimates in table 8 are based on measurements and observations of established plantings that have received adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from the local offices of the Natural Resources Conservation Service, the South Dakota Cooperative Extension Service, the South Dakota Division of Forestry, and the South Dakota Agricultural Experiment Station at South Dakota State University.

Figure 10.—Native cedar trees on breaks to the Cheyenne River in an area of Samsil clay, 25 to 60 percent slopes.

The soils in this county are assigned to windbreak suitability groups at the end of each description under the heading "Detailed Soil Map Units" and in the section "Interpretive Groups," which follows the tables at the back of this survey. A windbreak suitability group is a distinctive group of soils that supports trees and shrubs having similar growth and survival rates if weather conditions are normal and the windbreak is properly managed. The relationship between the soils and the growth of trees and shrubs was ascertained during this survey. Soil properties that affect the supply of moisture and plant nutrients, such as texture, available water capacity, and parent material, have the greatest influence on the growth of trees and shrubs. Soil reaction, salt content, and a seasonal high water table also are important. The following paragraphs describe the windbreak suitability groups.

Group 1. These soils are well suited to woody species. They are on high and low flood plains and on foot slopes. They receive additional moisture because of runoff and flooding. Some areas are subirrigated. All climatically suited trees and shrubs grow well.

This group consists mainly of loamy, silty, and clayey, somewhat poorly drained to well drained, very deep soils. Available water capacity is moderate or high. The soils that have a surface layer of fine sandy loam or fine sand

are subject to severe wind erosion. Craft, Haverson, Lohmiller, Nimbro, and Onita soils are in this group.

Group 2. These soils are well suited to woody species. They receive additional moisture because of runoff or have a high water table within the root zone. All climatically suited trees and shrubs grow well.

No soils in Haakon County are in this group.

Group 3. These soils are well suited to woody species. They are on summits, shoulder slopes, and back slopes. Except for the trees and shrubs that require an abundant moisture supply, all climatically suited trees and shrubs grow well.

This group consists of very deep, loamy and silty, well drained soils. Available water capacity is moderate or high. The susceptibility to water erosion ranges from slight on nearly level soils to severe on strongly sloping soils. The susceptibility to wind erosion ranges from slight to severe. Kirley, Nunn, Ree, and Savo soils are in this group.

Group 4. These soils are fairly well suited to woody species. They are on summits, shoulder slopes, back slopes, foot slopes, and high flood plains. Most of the climatically suited trees and shrubs grow well; however, maximum growth is not possible because of limited root development.

This group consists of moderately deep to very deep, moderately well drained and well drained soils. These are clayey soils or are clayey soils that have a loamy or silty surface layer. Available water capacity is low or moderate in the more clayey soils and moderate or high in the silty or loamy soils. Soils having accumulations of salts in the lower part of the subsoil also are in this group. The clayey soils are subject to severe wind erosion. The moderately sloping and strongly sloping soils are subject to severe water erosion. Hilmoe, Kyle, Opal, Ottumwa, Pierre, Promise, Razor, and Wendte soils are in this group.

Group 5. These soils are well suited to woody species. They are on high flood plains. All climatically suited trees and shrubs grow well, except for those that require an abundant moisture supply.

This group consists mainly of deep and very deep, loamy and sandy, well drained and somewhat excessively drained soils. Available water capacity generally is low or moderate. The soils are subject to severe or very severe wind erosion. Bankard soils are in this group.

Group 6. These soils are poorly suited to woody species. They are on summits and back slopes. No trees and shrubs grow well. Trees and shrubs can be established, but optimum survival and growth should not be expected. Field windbreaks are not effective because of a slow growth rate and a low height at maturity.

This group consists of silty and loamy, well drained and somewhat excessively drained soils that are moderately deep to bedrock or are shallow or moderately deep to sand and gravel. Available water capacity is low or moderate. The moderately sloping and strongly sloping soils are subject to severe water erosion. Blackpipe and Canning soils are in this group.

Group 7. These soils are poorly suited to woody species. No trees or shrubs grow well. Coniferous trees and shrubs grow better than deciduous trees and shrubs. Trees and shrubs can be established, but optimum survival and growth should not be expected. Field windbreaks are not effective because of a slow growth rate and a low height at maturity.

This group consists of very deep to moderately deep, sandy, somewhat excessively drained and excessively drained soils. Available water capacity is very low or low. The soils are subject to very severe wind erosion. The hummocky Bankard soils are in this group.

Group 8. These soils are poorly suited to woody species. They are on summits and back slopes. No trees and shrubs grow well. Trees and shrubs can be established, but optimum survival and growth should not be expected. Field windbreaks are not effective because of a slow growth rate and a low height at maturity.

This group consists of deep and moderately deep, loamy and silty, well drained soils that contain enough calcium carbonate at or near the surface for the growth and survival of trees and shrubs to be impaired. Available water capacity is moderate or high. The soils are subject to severe wind erosion and water erosion. Lakoma soils are in this group.

Group 9. These soils are poorly suited to woody species. They have a dense claypan subsoil and an excessive amount of salts in the lower part of the subsoil. They are on foot slopes. No trees and shrubs grow well because of the dense, sodium-affected claypan subsoil and the salts.

This group consists of moderately deep to very deep, silty and loamy, moderately well drained soils. Available water capacity is low or moderate. Mosher and Wortman soils are in this group.

Group 10. These soils generally are unsuited to woody species. They are shallow over bedrock, very shallow to gravel, very saline, very alkaline, or very wet. Some of the soils can be used for special plantings for wildlife, recreation, or beautification. The best sites should be

selected, and only the trees and shrubs that have the best potential to survive and grow well should be planted.

The soils in this group have a wide range of texture, depth, drainage, available water capacity, permeability, and slope. The susceptibility to water erosion and wind erosion ranges from slight to very severe. Albaton, Arvada, Bullcreek, Capa, Egas, Herdcamp, Hisle, Hoven, Kolls, Midway, Nihill, Okaton, Samsil, Sansarc, Schamber, Shingle, Vivian, and Wanblee soils are in this group. Also included are the steeper phases of Lakoma, Opal, Pierre, and Razor soils.

Recreation

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding or ponding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils that are subject to flooding or ponding are limited for recreational uses by the duration and intensity of flooding, the season when flooding occurs, and the duration of ponding. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding or ponding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding or ponding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding or ponding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding or ponding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Connie M. Vicuna, biologist, Natural Resources Conservation Service, helped prepare this section.

Wildlife is an abundant resource in Haakon County. It provides diverse recreational opportunities. It includes many native species that require large tracts of rangeland, such as sharp-tailed grouse, prairie chicken, antelope, and mule deer. Species that benefit from agriculture are common in some areas. These species include pheasants, white-tailed deer, and waterfowl. The waterfowl have become more abundant because of stock dams. Woody cover along the channels and in draws leading to the Bad and Cheyenne Rivers provides the primary habitat for white-tailed deer, turkeys, occasional bobcats, and beaver. The two rivers, some large dams, and farm or stock ponds provide habitat for limited numbers of fish.

Soils affect the kind and amount of vegetation and water available to wildlife for food and cover. Therefore, they also affect the distribution and abundance of wildlife. The abundance of wildlife in part depends on the amount and distribution of food, cover, and water. An understanding of soil capabilities is helpful in the development of wildlife habitat. This development includes planting desirable vegetation, maintaining the existing vegetation, promoting the natural establishment of desirable plants, and establishing watering facilities.

The 15 associations in Haakon County, which are

described under the heading "General Soil Map Units," provide some indication of the actual or potential distribution and density of wildlife species and wildlife habitat. A soil association represents a relatively uniform topographic unit with a distinct set of capabilities for producing and maintaining vegetation. Land use patterns and management practices tend to be uniform within a soil association.

The soil associations can be grouped according to their relative potential for wildlife habitat. The wildlife species in areas of these groups tend to be similar because of their preference for a particular kind of habitat. One group includes the Bankard-Craft-Wendte and Nimbro associations, which are along the Cheyenne River and the Bad River, respectively. This group has most of the native woodland in the county. A second group includes the Ottumwa-Razor-Midway, Okaton-Lakoma, Lakoma-Okaton, Pierre-Samsil, Samsil-Pierre, Midway-Razor-Blackpipe, and Kirley-Lakoma-Vivian associations, which are on river breaks and in the steeper areas throughout the county. This group is mainly native rangeland. A third group includes the Ree, Ottumwa-Lakoma-Kolls, Ottumwa-Lakoma, Pierre-Kyle, Promise-Opal-Ottumwa, and Ottumwa-Kirley associations. This group includes most of the cropland in the county.

Individual soils have different potentials for the development and maintenance of wildlife habitat elements. They affect the degree or extent to which habitat can be established or improved. In table 10 the soils in Haakon County are rated according to their potential for providing specific elements of wildlife habitat. This information can be used in planning parks, wildlife areas, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining the habitat elements; and in determining the intensity of management needed for each habitat element.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element. The element can be established, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element are very severe and that unsatisfactory results can be expected. Establishing, improving, or maintaining the element is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture also are considerations. Examples of grain and seed crops are wheat and sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture also are considerations. Examples of grasses and legumes are intermediate wheatgrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture also are considerations. Examples of wild herbaceous plants are western wheatgrass, green needlegrass, big bluestem, little bluestem, blue grama, prairie clovers, and vetches.

Planted trees and shrubs for windbreaks or other purposes generally require cultivation before and during establishment. They produce fruits, buds, bark, and foliage. Soil properties and features that affect the growth of planted trees and shrubs are depth of the root zone, available water capacity, salinity, soil reaction, fertility, and wetness. Examples of these trees and shrubs are green ash, Russian-olive, plum, chokecherry, Rocky Mountain juniper, and eastern redcedar.

Native deciduous trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, soil reaction, and wetness. Examples of these plants are oak, cottonwood, green ash, elm, plum, and chokecherry.

Native coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, soil reaction, and wetness. Examples of coniferous plants are cedar and juniper.

Native shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of native shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of these shrubs are skunkbush

sumac, gooseberry, western snowberry, buffaloberry, and sage.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average water depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

Information concerning the specific habitat elements needed to maintain specific wildlife species can be obtained from the local office of the Natural Resources Conservation Service or from the South Dakota Department of Game, Fish and Parks.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soil or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed

performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm, dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, and shrinking and swelling can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity by microorganisms. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is

disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, rock fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of about 5 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Reaction and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All

other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, salinity, available water capacity, permeability, porosity, content of organic matter, sodium adsorption ratio (SAR), and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even more than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage and piping and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by toxic substances in the root zone, such as salts, sodium, and sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by the cropping system, depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, restricted permeability, and other soil properties adversely affect maintenance.

Grassed waterways are established or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. Low available water capacity, restricted rooting depth, toxic substances such as salts and sodium, and restricted permeability adversely affect the establishment, growth, and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

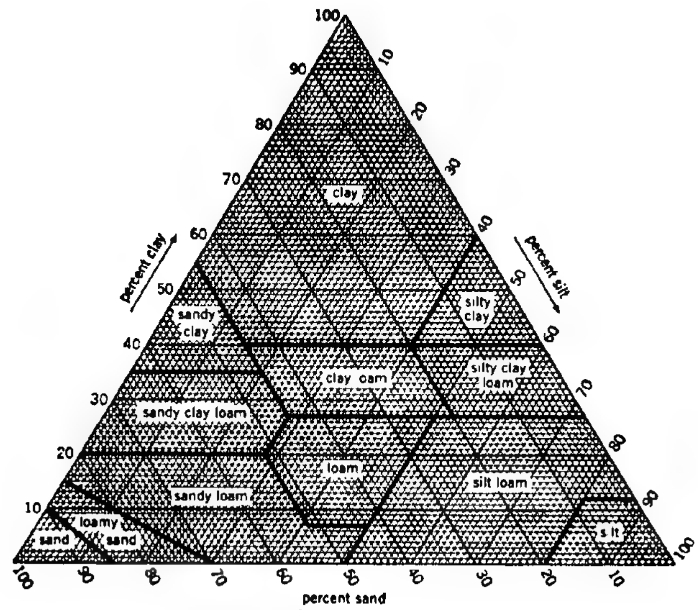

Figure 11.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. Information on other properties of each layer is given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 11). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in

group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at $^1/_3$- to $^1/_{10}$-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, porosity, compaction, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields. It is also considered in the design and management of irrigation systems and in the development of nutrient and pesticide management plans.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown, in the selection of a tillage system, in residue management decisions, in the use of herbicides and pesticides, and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in selecting pesticides, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of

water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production (by decreasing the availability of water to plants), the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on the basis of measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, more than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.10 to 0.43. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.

8. Soils that are not subject to wind erosion because of rock fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by limiting the removal of crop residue, by including high-residue crops in the crop rotation a high percentage of the time, and by applying livestock manure to the soil. Organic matter affects the available water capacity, porosity, bulk density, compaction, infiltration rate, the efficiency of pesticides, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep to very deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse

texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information about flooding is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed

as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(10)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning intermittent dryness, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplustolls (*Hapl*, meaning minimal horizonation, plus *ustoll*, the suborder of the Mollisols that has an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. An example is Vertic Haplustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, montmorillonitic, mesic Vertic Haplustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the underlying material can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(11)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(10)*. Unless otherwise stated, colors in the descriptions are for dry soil. No wet consistence is given for soil layers that are nonsticky and nonplastic. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Albaton Series

Depth to bedrock: Very deep
Drainage class: Very poorly drained
Permeability: Very slow
Landform: Flood plains
Parent material: Calcareous, clayey alluvium
Slope: 0 to 1 percent

Typical Pedon

Albaton silty clay, depressional, 2,520 feet west and 136

feet north of the southeast corner of sec. 5, T. 1 N., R. 25 E.

A1—0 to 4 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; common fine prominent strong brown (7.5YR 5/6) and gray (10YR 6/1) mottles; weak fine granular and subangular blocky structure; very hard, firm, slightly sticky and plastic; many roots; slight effervescence; slightly alkaline; clear smooth boundary.

A2—4 to 8 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; common fine prominent strong brown (7.5YR 5/6) and gray (10YR 6/1) mottles; weak coarse and medium subangular blocky structure; very hard, firm, sticky and plastic; many roots; slight effervescence; slightly alkaline; abrupt wavy boundary.

Cg1—8 to 40 inches; gray (5Y 5/1), stratified silty clay, dark gray (5Y 4/1) moist; many fine prominent strong brown (7.5YR 5/6) and light gray (10YR 7/1) mottles; massive; very hard, firm, sticky and plastic; many roots to a depth of 26 inches and common roots to a depth of 40 inches; strong effervescence; slightly alkaline; clear wavy boundary.

Cg2—40 to 60 inches; gray (5Y 5/1), stratified silty clay, dark gray (5Y 4/1) moist; common fine prominent brownish yellow (10YR 6/6) and gray (10YR 6/1) mottles; massive; very hard, firm, sticky and plastic; few roots to a depth of 45 inches; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 6 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR or 2.5Y; value—4 or 5 (3 moist); and chroma—1 or 2
Texture—dominantly silty clay but clay in some pedons

Cg horizon:
Hue—5Y or 2.5Y; value—4 or 5 (3 or 4 moist); and chroma—1 or 2
Texture—silty clay or clay

Some pedons have coarser textured material below a depth of 40 inches.

Arvada Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Very slow
Landform: Plains
Parent material: Clayey residuum
Slope: 0 to 4 percent

Typical Pedon

Arvada silt loam, 2,239 feet west and 300 feet south of the northeast corner of sec. 16, T. 2 N., R. 18 E.

E—0 to 3 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; many roots; neutral; abrupt smooth boundary.

Btn1—3 to 9 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; light brownish gray (10YR 6/2) coatings on the top of columns; moderate medium columnar structure parting to moderate fine subangular blocky; extremely hard, firm, sticky and plastic; shiny films on faces of peds; many roots; moderately alkaline; clear wavy boundary.

Btn2—9 to 14 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse subangular blocky structure; very hard, firm, sticky and slightly plastic; shiny films on faces of peds; many roots; moderately alkaline; clear wavy boundary.

Bkyz1—14 to 22 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; very hard, firm, sticky and slightly plastic; common roots; few fine accumulations of carbonate; many fine masses of gypsum and other salts; strong effervescence; strongly alkaline; gradual wavy boundary.

Bkyz2—22 to 43 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; hard, friable, sticky and slightly plastic; few roots; many fine masses of gypsum and other salts; strong effervescence; strongly alkaline; clear wavy boundary.

Cyz—43 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, sticky and slightly plastic; common fine and medium masses of gypsum and other salts; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 7 to 14 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: 10 to 15 inches

E horizon:
Hue—10YR; value—5 to 7 (4 or 5 moist); and chroma—2 or 3
Texture—dominantly silt loam but loam or fine sandy loam in some pedons

Btn horizon:
Hue—10YR or 2.5Y; value—4 to 6 (4 or 5 moist); and chroma—2 to 4
Texture—clay, silty clay, or silty clay loam

Bkyz horizon:
Hue—10YR or 2.5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—dominantly silty clay loam but clay loam in some pedons

Cyz horizon:
Hue—10YR or 2.5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—dominantly silty clay loam but clay loam in some pedons

Bankard Series

Depth to bedrock: Very deep
Drainage class: Somewhat excessively drained
Permeability: Rapid
Landform: Flood plains
Parent material: Sandy alluvium
Slope: 0 to 6 percent

Typical Pedon

Bankard loamy sand, hummocky, 2,590 feet west and 1,850 feet south of the northeast corner of sec. 16, T. 7 N., R. 20 E.

A—0 to 6 inches; grayish brown (2.5Y 5/2) loamy sand, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; common roots; slight effervescence; slightly alkaline; abrupt wavy boundary.
C—6 to 60 inches; pale brown (10YR 6/3) sand, brown (10YR 5/3) moist; massive; loose; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 3 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR or 2.5Y; value—5 or 6 (3 to 5 moist); and chroma—2 or 3
Texture—dominantly loamy sand or very fine sandy loam but sandy loam or loam in some pedons

C horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 to 4
Texture—sand or gravelly sand

Blackpipe Series

Depth to bedrock: Moderately deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Plains
Parent material: Clayey residuum
Slope: 0 to 6 percent

Typical Pedon

Blackpipe silty clay loam, 0 to 2 percent slopes, 1,816 feet east and 2,506 feet south of the northwest corner of sec. 21, T. 3 N., R. 18 E.

A—0 to 4 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, very friable; many roots; neutral; abrupt smooth boundary.
Bt1—4 to 8 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate medium and coarse subangular blocky; hard, friable; shiny films on faces of peds; many roots; slightly alkaline; clear smooth boundary.
Bt2—8 to 17 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to strong fine and medium subangular blocky; hard, friable; shiny films on faces of peds; many roots; slightly alkaline; clear wavy boundary.
Bk1—17 to 23 inches; light brownish gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) moist; moderate medium subangular blocky structure; hard, friable; common roots; common fine accumulations of carbonate; strong effervescence; slightly alkaline; clear smooth boundary.
Bk2—23 to 28 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; weak coarse subangular blocky structure; slightly hard, friable; few roots; many fine accumulations of carbonate; strong effervescence; slightly alkaline; clear wavy boundary.
Cr—28 to 60 inches; light yellowish brown (2.5Y 6/4) and light brown (7.5YR 6/3) siltstone, light olive brown (2.5Y 5/4) and brown (7.5YR 5/3) moist; massive; hard, friable; few roots to a depth of 36 inches; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 10 inches
Depth to carbonates: 14 to 23 inches

Depth to contrasting parent material: 20 to 40 inches over siltstone bedrock
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR; value—3 to 5 (2 or 3 moist); and chroma—1 or 2
Texture—dominantly silty clay loam but silt loam in some pedons

Bt horizon:
Hue—10YR; value—3 to 5 (2 to 4 moist); and chroma—1 or 2
Texture—silty clay loam

Bk horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 or 5 moist); and chroma—1 or 2
Texture—silty clay loam

Cr horizon:
Hue—10YR, 2.5Y, or 7.5YR; value—6 or 7 (5 or 6 moist); and chroma—3 or 4
Kind of bedrock—siltstone

Bullcreek Series

Depth to bedrock: Very deep
Drainage class: Well drained and moderately well drained
Permeability: Very slow
Landform: Fans or terraces
Parent material: Clayey alluvium
Slope: 0 to 6 percent

Typical Pedon

Bullcreek clay, 0 to 6 percent slopes, 100 feet north and 2,105 feet east of the southwest corner of sec. 34, T. 4 N., R. 23 E.

A—0 to 3 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; weak fine granular structure; hard, friable, sticky and plastic; common roots; cracks 0.5 inch wide; slightly alkaline; clear smooth boundary.

Bss1—3 to 6 inches; grayish brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm, sticky and plastic; common roots; cracks 0.5 inch wide; few intersecting slickensides; slight effervescence; slightly alkaline; clear wavy boundary.

Bss2—6 to 16 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; extremely hard, firm, sticky and plastic; common roots; cracks 0.5 inch wide; many prominent intersecting slickensides, which are tilted 30 degrees from horizontal and are 0.5 inch to 2.0 inches wide; slight effervescence; slightly alkaline; gradual wavy boundary.

Bssyz—16 to 26 inches; olive (5Y 5/3) clay, olive (5Y 4/3) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; extremely hard, firm, sticky and plastic; few roots; cracks 0.5 inch wide; common prominent intersecting slickensides, which are tilted 35 degrees from horizontal and are 0.5 inch to 2.0 inches wide; many fine masses of gypsum and other salts; strong effervescence; slightly alkaline; gradual wavy boundary.

Cyz1—26 to 44 inches; olive (5Y 5/3) clay, olive (5Y 4/3) moist; massive; hard, firm, sticky and plastic; few roots to a depth of 36 inches; common fine masses of gypsum and other salts; strong effervescence; moderately alkaline; clear wavy boundary.

Cyz2—44 to 60 inches; olive (5Y 5/3) clay, olive (5Y 4/3) moist; massive; hard, firm, sticky and plastic; few medium accumulations of carbonate; common fine masses of gypsum and other salts; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 20 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: 6 to 20 inches

A horizon:
Hue—2.5Y or 5Y; value—4 or 5 (2 or 3 moist); and chroma—1 or 2
Texture—dominantly clay but silty clay in some pedons

Bss horizon:
Hue—2.5Y or 5Y; value—4 or 5 (3 or 4 moist); and chroma—2 or 3
Texture—clay

Byz horizon:
Hue—2.5Y or 5Y; value—4 to 6 (3 or 4 moist); and chroma—2 or 3
Texture—clay

C horizon:
Hue—2.5Y or 5Y; value—5 or 6 (4 or 5 moist); and chroma—2 to 4
Texture—clay

Canning Series

Depth to bedrock: Very deep
Drainage class: Well drained

Permeability: Moderate in the solum and rapid in the underlying material
Landform: Terraces
Parent material: Loamy alluvium
Slope: 0 to 9 percent

Typical Pedon

Canning loam, in an area of Ree-Canning loams, 6 to 9 percent slopes, 2,190 feet south and 2,150 feet west of the northeast corner of sec. 15, T. 6 N., R. 19 E.

A—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.
Bt1—6 to 11 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; shiny films on faces of peds; neutral; clear smooth boundary.
Bt2—11 to 18 inches; brown (10YR 5/3) clay loam, dark grayish brown (10YR 4/2) moist; weak medium and coarse prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; shiny films on faces of peds; neutral; clear smooth boundary.
Bk—18 to 27 inches; pale brown (10YR 6/3) gravelly loam, brown (10YR 5/3) moist; weak medium and coarse subangular blocky structure; hard, friable; few fine accumulations of carbonate; strong effervescence; slightly alkaline; gradual wavy boundary.
2C—27 to 60 inches; light yellowish brown (10YR 6/4) gravelly fine sand and medium sand, yellowish brown (10YR 5/4) moist; single grain; loose; about 30 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 14 inches
Depth to carbonates: 16 to 25 inches
Depth to contrasting parent material: 20 to 40 inches over sand and gravel
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR; value—4 or 5 (2 or 3 moist); and chroma—1 or 2
Texture—loam

Bt horizon:
Hue—10YR; value—4 or 5 (2 to 4 moist); and chroma—2 or 3
Texture—clay loam or sandy clay loam

Bk horizon:
Hue—10YR or 2.5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—gravelly loam or clay loam

2C horizon:
Hue—10YR; value—5 to 7 (4 to 6 moist); and chroma—3 or 4
Texture—gravelly sand

Capa Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Very slow
Landform: Plains
Parent material: Clayey residuum
Slope: 0 to 6 percent

Typical Pedon

Capa silt loam, 0 to 6 percent slopes, 530 feet west and 1,063 feet south of the northeast corner of sec. 26, T. 3 N., R. 24 E.

E—0 to 2 inches; gray (10YR 5/1) silt loam, dark gray (10YR 4/1) moist; weak thin platy structure; soft, very friable; many roots; neutral; abrupt smooth boundary.
Btn1—2 to 7 inches; grayish brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; weak medium columnar structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; shiny films on faces of peds; many roots; moderately alkaline; clear wavy boundary.
Btn2—7 to 14 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak medium and coarse subangular blocky structure; hard, firm, sticky and plastic; shiny films on faces of peds; common roots; strong effervescence; moderately alkaline; clear wavy boundary.
Btknyz—14 to 20 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; hard, firm, sticky and plastic; shiny films on faces of peds; few roots; few fine accumulations of carbonate; many fine masses of gypsum and other salts; strong effervescence; moderately alkaline; gradual wavy boundary.
Bkyz—20 to 28 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; hard, friable, sticky and plastic; common fine accumulations of carbonate; many fine masses of gypsum and other salts; strong effervescence; moderately alkaline; gradual wavy boundary.
Cyz—28 to 52 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; massive; hard,

firm, sticky and plastic; few fine accumulations of carbonate; many medium masses of gypsum and other salts; strong effervescence; moderately alkaline; gradual wavy boundary.

C—52 to 60 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky and plastic; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 12 inches
Depth to carbonates: 4 to 12 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: 6 to 16 inches

E horizon:
Hue—10YR or 2.5Y; value—5 or 6 (4 or 5 moist); and chroma—1 or 2
Texture—dominantly silt loam but loam in some pedons

Btn horizon:
Hue—10YR or 2.5Y; value—4 or 5 (2 to 4 moist); and chroma—1 or 2
Texture—clay

Btnkyz horizon:
Hue—10YR or 2.5Y; value—5 or 6 (4 or 5 moist); and chroma—1 or 2
Texture—clay

Bkyz horizon:
Hue—10YR, 2.5Y, or 5Y; value—5 or 6 (4 or 5 moist); and chroma—1 or 2
Texture—clay or silty clay

C horizon:
Hue—2.5Y or 5Y; value—5 to 7 (4 to 6 moist); and chroma—1 or 2
Texture—clay or silty clay

Craft Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Flood plains
Parent material: Loamy alluvium
Slope: 0 to 2 percent

Typical Pedon

Craft very fine sandy loam, 2,354 feet west and 2,186 feet north of the southeast corner of sec. 5, T. 7 N., R. 22 E.

Ap—0 to 5 inches; grayish brown (10YR 5/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular and weak medium subangular blocky structure; slightly hard, very friable; many roots; strong effervescence; moderately alkaline; abrupt smooth boundary.

C1—5 to 14 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to moderate coarse subangular blocky; slightly hard, very friable; many roots; slight effervescence; moderately alkaline; abrupt wavy boundary.

C2—14 to 36 inches; light brownish gray (10YR 6/2) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; common roots; strong effervescence; slightly alkaline; abrupt wavy boundary.

C3—36 to 42 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; few roots; strong effervescence; slightly alkaline.

C4—42 to 60 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 2 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR; value—5 or 6 (3 to 5 moist); and chroma—2
Texture—dominantly very fine sandy loam but loam in some pedons

C horizon:
Hue—10YR or 2.5Y; value—6 or 7 (4 to 6 moist); and chroma—1 to 3
Texture—dominantly very fine sandy loam or silt loam but loam in some pedons

Egas Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Flood plains
Parent material: Clayey alluvium
Slope: 0 to 2 percent

Typical Pedon

Egas silty clay loam, 156 feet north and 908 feet west of the southeast corner of sec. 26, T. 6 N., R. 19 E.

A—0 to 6 inches; grayish brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; weak fine

granular and weak medium subangular blocky structure; hard, firm, sticky and slightly plastic; many roots; slight effervescence; moderately alkaline; clear smooth boundary.

ACz—6 to 11 inches; grayish brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak coarse prismatic structure; hard, firm, sticky and slightly plastic; common roots; common masses of salts; slight effervescence; strongly alkaline; clear wavy boundary.

C1—11 to 16 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive; very hard, firm, sticky and slightly plastic; few roots; disseminated salts; peds becoming encrusted with white salts upon drying; slight effervescence; moderately alkaline; gradual wavy boundary.

C2—16 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive; very hard, firm, sticky and slightly plastic; few roots to a depth of 30 inches; disseminated salts; peds becoming encrusted with white salts upon drying; slight effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 20 inches
Depth to carbonates: 0 to 10 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: 0 to 6 inches

A horizon:
Hue—10YR or 2.5Y; value—4 or 5 (2 or 3 moist); and chroma—1 or 2
Texture—dominantly silty clay loam but silty clay in some pedons

ACz horizon:
Hue—10YR or 2.5Y; value—5 or 6 (3 or 4 moist); and chroma—1 or 2
Texture—silty clay or silty clay loam

C horizon:
Hue—2.5Y or 5Y; value—5 or 6 (4 or 5 moist); and chroma—1 or 2
Texture—silty clay or silty clay loam

Haverson Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Flood plains
Parent material: Silty alluvium
Slope: 0 to 2 percent

Typical Pedon

Haverson silt loam, channeled, 168 feet east and 605 feet south of the northwest corner of sec. 1, T. 1 N., R. 19 E.

A1—0 to 4 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak fine granular and subangular blocky structure; slightly hard, very friable; many roots; slightly alkaline; clear smooth boundary.

A2—4 to 8 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; slightly hard, friable; many roots; slight effervescence; slightly alkaline; abrupt smooth boundary.

A3—8 to 12 inches; dark grayish brown (2.5Y 4/2) silt loam, very dark grayish brown (2.5Y 3/2) moist; moderate medium prismatic structure parting to weak fine subangular blocky; slightly hard, very friable; many roots; strong effervescence; slightly alkaline; clear smooth boundary.

C1—12 to 21 inches; light olive brown (2.5Y 5/3) silty clay loam stratified with thin lenses of fine sandy loam or fine sand; olive brown (2.5Y 4/3) moist; weak coarse subangular blocky structure parting to moderate medium subangular blocky; slightly hard, friable; common roots; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—21 to 40 inches; light yellowish brown (2.5Y 6/3) silty clay loam stratified with thin lenses of fine sandy loam or fine sand; light olive brown (2.5Y 5/3) moist; massive; hard, friable; common roots to a depth of 27 inches and few roots to a depth of 40 inches; violent effervescence; moderately alkaline; clear wavy boundary.

C3—40 to 55 inches; light olive brown (2.5Y 5/3) silty clay loam stratified with thin lenses of fine sandy loam or fine sand; olive brown (2.5Y 4/3) moist; massive; hard, friable; strong effervescence; moderately alkaline; clear wavy boundary.

C4—55 to 60 inches; light yellowish brown (2.5Y 6/3) silty clay loam stratified with thin lenses of fine sandy loam or fine sand; olive brown (2.5Y 4/3) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 4 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR or 2.5Y; value—5 or 6 (3 to 5 moist); and chroma—2 or 3
Texture—silt loam

C horizon:
Hue—10YR or 2.5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—dominantly silty clay loam stratified with thin lenses of fine sandy loam or fine sand but fine sandy loam or sand in some pedons

Herdcamp Series

Depth to bedrock: Very deep
Drainage class: Very poorly drained
Permeability: Slow
Landform: Flood plains
Parent material: Clayey alluvium
Slope: 0 to 2 percent

Typical Pedon

Herdcamp silty clay, in an area of Wendte-Herdcamp silty clays, channeled, 1,905 feet east and 2,105 feet north of the southwest corner of sec. 17, T. 3 N., R. 23 E.

Az—0 to 5 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; many prominent gray (10YR 6/1) mottles; weak fine granular and weak medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; many roots; many fine prominent reddish yellow (7.5YR 6/6) iron stains; few fine nests of gypsum and other salts; slight effervescence; slightly alkaline; clear smooth boundary.

Czg1—5 to 15 inches; gray (5Y 5/1) silty clay, very dark gray (5Y 3/1) moist; many fine prominent gray (10YR 6/1) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, firm, sticky and slightly plastic; many roots; many fine prominent strong brown (7.5YR 5/6) iron stains; few fine nests of gypsum and other salts; strong effervescence; slightly alkaline; clear wavy boundary.

Czg2—15 to 27 inches; gray (5Y 5/1) silty clay, dark gray (5Y 4/1) moist; common fine distinct gray (10YR 6/1) mottles; massive; hard, firm, sticky and slightly plastic; common roots; many fine prominent strong brown (7.5YR 5/6) iron stains; few fine nests of gypsum and other salts; strong effervescence; moderately alkaline; gradual wavy boundary.

Czg3—27 to 60 inches; gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; many fine distinct gray (10YR 6/1) mottles; massive; hard, firm, slightly sticky and plastic; few roots to a depth of 38 inches; many fine prominent brownish yellow (10YR 6/6) iron stains; few fine nests of gypsum and other salts; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 20 inches
Depth to carbonates: 0 to 10 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: 0 to 15 inches

Az horizon:
Hue—neutral, 10YR, 2.5Y, or 5Y; value—3 or 4 (2 or 3 moist); and chroma—0 or 1
Texture—dominantly silty clay but clay or silty clay loam in some pedons

Czg horizon:
Hue—neutral, 2.5Y, or 5Y; value—4 or 5 (3 or 4 moist); and chroma—0 to 2
Texture—silty clay or clay

Hilmoe Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Slow
Landform: Flood plains
Parent material: Clayey alluvium over silty alluvium
Slope: 0 to 2 percent

Typical Pedon

Hilmoe silty clay, 2,373 feet west and 1,637 feet south of the northeast corner of sec. 23, T. 1 N., R. 20 E.

Ap—0 to 6 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; weak fine granular and weak medium subangular blocky structure; hard, friable, sticky and slightly plastic; many roots; strong effervescence; moderately alkaline; abrupt smooth boundary.

AC—6 to 15 inches; gray (10YR 5/1) silty clay, dark gray (10YR 4/1) moist; weak very coarse subangular blocky structure; extremely hard, firm, slightly sticky and plastic; many roots; strong effervescence; moderately alkaline; clear wavy boundary.

Cyz1—15 to 26 inches; gray (10YR 5/1) silty clay, dark gray (10YR 4/1) moist; massive; extremely hard, firm, slightly sticky and plastic; common roots; few fine accumulations of carbonate; few fine masses of gypsum and other salts; slight effervescence; moderately alkaline; abrupt wavy boundary.

Cyz2—26 to 37 inches; light gray (10YR 7/2) clay loam, grayish brown (10YR 5/2) moist; massive; hard, friable, sticky and slightly plastic; few roots; few fine masses of gypsum and other salts; strong effervescence; slightly alkaline; gradual wavy boundary.

2Cyz3—37 to 60 inches; light brownish gray (10YR 6/2) fine sandy loam stratified with thin lenses of finer

textured material; grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; few fine masses of gypsum and other salts; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 9 inches
Depth to carbonates: 0 to 3 inches
Depth to contrasting parent material: 20 to 40 inches over silty alluvium
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR or 2.5Y; value—4 or 5 (2 or 3 moist); and chroma—1 or 2
Texture—dominantly silty clay but silt loam or silty clay loam in some pedons

C horizon:
Hue—10YR or 2.5Y; value—5 or 6 (3 or 4 moist); and chroma—1 or 2
Texture—dominantly silty clay or clay but silty clay loam in some pedons

2C horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 or 3
Texture—dominantly fine sandy loam, loam, or silt loam but very fine sandy loam or clay loam in some pedons

The Hilmoe soils in this county have mollic colors that extend to a lesser depth than is defined as the range for the series. This difference, however, does not significantly alter the usefulness or behavior of the soils.

Hisle Series

Depth to bedrock: Moderately deep
Drainage class: Well drained
Permeability: Very slow
Landform: Plains
Parent material: Clayey residuum
Slope: 0 to 6 percent

Typical Pedon

Hisle silt loam, 0 to 6 percent slopes, 880 feet north and 2,180 feet west of the southeast corner of sec. 12, T. 1 S., R. 16 E. (from Pennington County, South Dakota):

E—0 to 2 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium platy structure parting to weak fine granular; soft, very friable; many roots; neutral; abrupt smooth boundary.

Btn1—2 to 5 inches; brown (10YR 5/3) silty clay, brown (10YR 4/3) moist; weak fine and medium columnar structure parting to moderate fine blocky; hard, very firm, sticky and plastic; shiny films on faces of peds; many roots; slight effervescence; moderately alkaline; clear smooth boundary.

Btn2—5 to 15 inches; brown (10YR 5/3) silty clay, brown (10YR 4/3) moist; weak medium prismatic structure parting to moderate medium blocky; hard, very firm, sticky and plastic; shiny films on faces of peds; many roots; strong effervescence; slightly alkaline; clear wavy boundary.

Bkz—15 to 21 inches; pale brown (10YR 6/3) silty clay, brown (10YR 5/3) moist; moderate medium blocky structure; hard, very firm, sticky and plastic; common roots; few fine accumulations of carbonate; few fine masses of salts; strong effervescence; moderately alkaline; clear wavy boundary.

C—21 to 28 inches; pale brown (10YR 6/3) silty clay, brown (10YR 5/3) moist; massive; hard, very firm, sticky and plastic; few roots; few fine accumulations of carbonate; 30 percent, by volume, soft fine shale fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

Cr—28 to 60 inches; light gray (10YR 7/2), soft shale, grayish brown (10YR 5/2) moist; slight effervescence.

Range in Characteristics

Depth to carbonates: 1 to 12 inches
Depth to contrasting parent material: 20 to 40 inches over shale bedrock
Depth to gypsum and other visible salts: 6 to 16 inches

E horizon:
Hue—10YR or 2.5Y; value—5 to 7 (3 to 5 moist); and chroma—1 to 3
Texture—dominantly silt loam but loam in some pedons

Btn horizon:
Hue—10YR or 2.5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—silty clay or clay

Bkz horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 or 5 moist); and chroma—2 or 3
Texture—silty clay or clay

C horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 or 5 moist); and chroma—2 or 3
Texture—silty clay or clay

Cr horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 or 3
Kind of bedrock—shale

Hoven Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Very slow
Landform: Plains
Parent material: Clayey alluvium
Slope: 0 to 1 percent

Typical Pedon

Hoven silt loam, 1,883 feet east and 2,018 feet north of the southwest corner of sec. 28, T. 7 N., R. 24 E.

E—0 to 3 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; many fine prominent brownish yellow (10YR 6/6) mottles; moderate thin platy structure; soft, very friable; many roots; neutral; abrupt smooth boundary.

Btn1—3 to 7 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; continuous gray (10YR 5/1) coatings on the top of columns and thin coatings on vertical faces of peds; few fine prominent brownish yellow (10YR 6/6) mottles; moderate medium columnar structure parting to strong medium blocky; extremely hard, firm, sticky and very plastic; shiny films on faces of peds; many roots; neutral; clear wavy boundary.

Btn2—7 to 16 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate coarse subangular blocky structure parting to moderate fine and medium subangular blocky; extremely hard, firm, sticky and very plastic; shiny films on faces of peds; many roots; slightly alkaline; gradual wavy boundary.

Btn3—16 to 23 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; weak coarse subangular blocky structure parting to weak fine and medium subangular blocky; extremely hard, firm, sticky and very plastic; shiny films on faces of peds; common roots; slightly alkaline; gradual wavy boundary.

Bk—23 to 33 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; weak coarse subangular blocky structure; hard, firm, slightly sticky and very plastic; few roots; few fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

Cyz1—33 to 45 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, slightly sticky and very plastic; few roots; few fine masses of gypsum and other salts; strong effervescence; moderately alkaline; clear wavy boundary.

Cyz2—45 to 60 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, slightly sticky and very plastic; many fine masses and striations of gypsum and other salts; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 20 to 30 inches
Depth to carbonates: 10 to 30 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: 10 to 45 inches

E horizon:
Hue—10YR; value—5 to 7 (3 or 4 moist); and chroma—1 or 2
Texture—silt loam

Btn horizon:
Hue—10YR or 2.5Y; value—4 or 5 (2 or 3 moist); and chroma—1 or 2
Texture—silty clay or clay

Bk horizon:
Hue—10YR or 2.5Y; value—4 to 6 (3 or 4 moist); and chroma—1 or 2
Texture—dominantly silty clay but clay in some pedons

Cyz horizon:
Hue—10YR or 2.5Y; value—5 or 6 (4 or 5 moist); and chroma—1 or 2
Texture—silty clay or clay

Kirley Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Terraces
Parent material: Clayey alluvium
Slope: 0 to 15 percent

Typical Pedon

Kirley clay loam, 2 to 6 percent slopes, 1,100 feet east and 2,500 feet south of the northwest corner of sec. 11, T. 3 N., R. 19 E.

A—0 to 5 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak and moderate medium granular and weak medium subangular blocky structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

Bt1—5 to 13 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; shiny films on faces of peds; slightly acid; clear smooth boundary.

Bt2—13 to 21 inches; grayish brown (2.5Y 5/2) clay, dark

grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; shiny films on faces of peds; slight effervescence; neutral; clear wavy boundary.

Bk—21 to 34 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak medium and coarse subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common fine and medium accumulations of carbonate; violent effervescence; slightly alkaline; gradual wavy boundary.

C—34 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, firm, slightly sticky and slightly plastic; few fine and medium accumulations of carbonate; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 18 inches
Depth to carbonates: 12 to 20 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR; value—4 or 5 (2 or 3 moist); and chroma—1 or 2
Texture—dominantly clay loam but loam in some pedons

Bt horizon:
Hue—10YR or 2.5Y; value—4 or 5 (3 or 4 moist); and chroma—2 or 3
Texture—dominantly clay but clay loam or sandy clay in some pedons

Bk horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 to 4
Texture—clay loam or clay

C horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 to 4
Texture—clay loam or clay

Kolls Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Very slow
Landform: Plains
Parent material: Clayey alluvium
Slope: 0 to 1 percent

Typical Pedon

Kolls clay, 2,158 feet east and 2,192 feet north of the southwest corner of sec. 14, T. 3 N., R. 24 E.

A—0 to 4 inches; gray (10YR 5/1) clay, very dark gray (10YR 3/1) moist; weak fine granular and moderate medium subangular blocky structure; hard, firm, sticky and very plastic; many roots; cracks 0.75 inch wide; moderately alkaline; abrupt smooth boundary.

Bg—4 to 12 inches; gray (5Y 5/1) clay, very dark gray (5Y 3/1) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; extremely hard, firm, sticky and very plastic; many roots; cracks 0.5 inch wide; strong effervescence; moderately alkaline; clear wavy boundary.

Bssg1—12 to 26 inches; gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; weak coarse subangular blocky structure; extremely hard, firm, sticky and very plastic; common roots; cracks 0.25 inch wide; common distinct intersecting slickensides; strong effervescence; moderately alkaline; gradual wavy boundary.

Bssg2—26 to 32 inches; gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; weak coarse subangular blocky structure; extremely hard, firm, sticky and plastic; few roots; few distinct nonintersecting slickensides; strong effervescence; moderately alkaline; clear wavy boundary.

Cyzg1—32 to 46 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; extremely hard, firm, sticky and plastic; few fine masses of gypsum and other salts; strong effervescence; moderately alkaline; clear wavy boundary.

Cyzg2—46 to 60 inches; gray (2.5Y 5/1) clay, dark gray (2.5Y 4/1) moist; massive; very hard, firm, sticky and plastic; many fine and medium masses of gypsum and other salts; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 30 inches
Depth to carbonates: 0 to 10 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: 20 to 35 inches

A horizon:
Hue—neutral, 10YR, or 2.5Y; value—4 or 5 (2 or 3 moist); and chroma—0 or 1
Texture—dominantly clay but silty clay in some pedons

Bg horizon:
Hue—neutral, 2.5Y, or 5Y; value—4 or 5 (2 or 3 moist); and chroma—0 or 1
Texture—clay

Bssg horizon:
Hue—neutral, 10YR, 2.5Y, or 5Y; value—5 or 6 (4 or 5 moist); and chroma—0 or 1
Texture—clay

Cyzg horizon:
Hue—neutral, 2.5Y, or 5Y; value—4 to 6 (3 to 5 moist); and chroma—0 to 3
Texture—clay

Some pedons have a BCssyzg horizon, and some have a Cssyzg horizon.

Kyle Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Very slow
Landform: Plains
Parent material: Clayey residuum
Slope: 0 to 6 percent

Typical Pedon

Kyle clay, 0 to 3 percent slopes, 134 feet north and 2,340 feet east of the southwest corner of sec. 1, T. 3 N., R. 22 E.

Ap—0 to 4 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium and coarse subangular blocky and weak fine granular structure; hard, firm, sticky and plastic; common roots; cracks 0.5 inch wide; slightly alkaline; abrupt smooth boundary.

Bss1—4 to 11 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium and coarse subangular blocky structure; extremely hard, very firm, sticky and plastic; common roots; cracks 0.5 inch wide; common distinct intersecting slickensides, which are tilted 20 degrees from horizontal; slight effervescence; slightly alkaline; gradual wavy boundary.

Bss2—11 to 22 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium and coarse blocky and subangular blocky structure; extremely hard, very firm, sticky and plastic; few roots; cracks 0.25 inch wide; common prominent intersecting slickensides, which are tilted 25 degrees from horizontal; slight effervescence; moderately alkaline; clear wavy boundary.

Bkss—22 to 27 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium and coarse blocky and subangular blocky structure; extremely hard, very firm, sticky and plastic; few roots; cracks 0.25 inch wide; few distinct intersecting slickensides, which are tilted 30 degrees from horizontal; few medium accumulations of carbonate; slight effervescence; slightly alkaline; gradual wavy boundary.

Bkssyz—27 to 36 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; extremely hard, very firm, sticky and plastic; few roots; few faint nonintersecting slickensides, which are tilted 35 degrees from horizontal; few fine accumulations of carbonate; few fine nests of gypsum and other salts; slight effervescence; slightly alkaline; clear wavy boundary.

Cyz1—36 to 46 inches; light olive brown (2.5Y 5/3) clay, olive brown (2.5Y 4/3) moist; massive; hard, firm, sticky and plastic; common nests and seams of gypsum and other salts; slight effervescence; slightly alkaline; gradual wavy boundary.

Cyz2—46 to 60 inches; light olive brown (2.5Y 5/3) clay, olive brown (2.5Y 4/3) moist; massive; hard, firm, sticky and plastic; many nests and seams of gypsum and other salts; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 6 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: 20 to 40 inches

A horizon:
Hue—10YR or 2.5Y; value—5 or 6 (3 to 5 moist); and chroma—1 to 3
Texture—dominantly clay but silty clay in some pedons

Bss horizon:
Hue—2.5Y or 5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—clay

Bkss horizon:
Hue—2.5Y or 5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—clay

Cyz horizon:
Hue—2.5Y or 5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—clay

Some pedons have a Bw horizon, and some have a BCss or BCssy horizon.

Lakoma Series

Depth to bedrock: Moderately deep
Drainage class: Well drained
Permeability: Slow

Landform: Dissected plains
Parent material: Clayey residuum
Slope: 3 to 30 percent

Typical Pedon

Lakoma silty clay, 6 to 9 percent slopes (fig. 12), 1,905 feet north and 2,640 feet west of the southeast corner of sec. 27, T. 7 N., R. 24 E.

A—0 to 5 inches; dark grayish brown (2.5Y 4/2) silty clay that crushes to grayish brown (2.5Y 5/2), very dark grayish brown (2.5Y 3/2) crushing to dark grayish brown (2.5Y 4/2) moist; weak fine granular and subangular blocky structure; slightly hard, friable, sticky and plastic; many roots; slight effervescence; moderately alkaline; clear smooth boundary.

Bw—5 to 14 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak very coarse subangular blocky structure; hard, firm, sticky and slightly plastic; many roots; strong effervescence; moderately alkaline; clear wavy boundary.

Bk—14 to 21 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; hard, firm, sticky and slightly plastic; common roots; many fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C—21 to 28 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, sticky and slightly plastic; few roots; about 20 percent, by volume, partially weathered fragments of shale; violent effervescence; moderately alkaline; clear wavy boundary.

Cr—28 to 60 inches; light gray (2.5Y 7/2) shale, grayish brown (2.5Y 5/2) moist; many yellow (2.5Y 7/6) and few dark yellowish brown (10YR 4/4) iron stains; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 7 inches
Depth to contrasting parent material: 20 to 40 inches over shale bedrock
Depth to gypsum and other visible salts: 20 to more than 60 inches

A horizon:
Hue—2.5Y or 10YR; value—4 to 6 (3 to 5 moist); and chroma—2 or 3
Texture—dominantly silty clay but clay in some pedons

Bw horizon:
Hue—2.5Y or 10YR; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—silty clay or clay

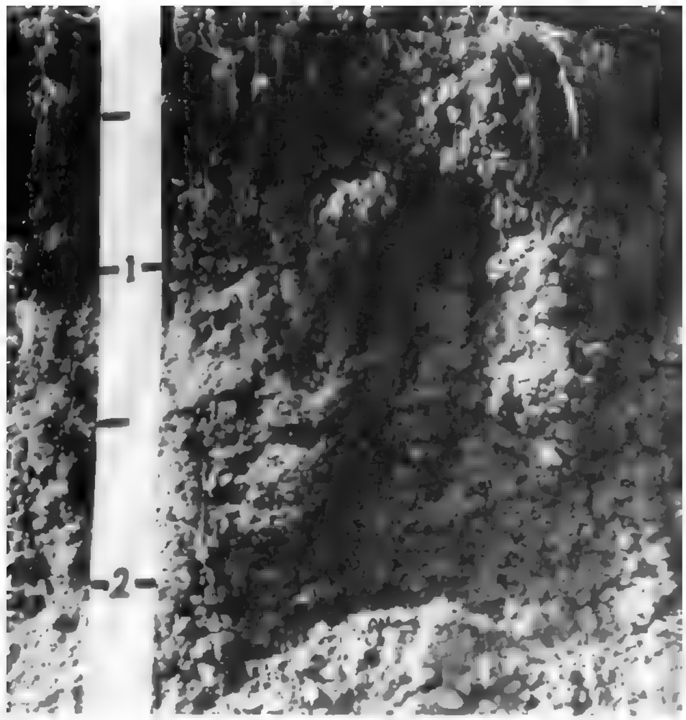

Figure 12.—Profile of Lakoma silty clay, 6 to 9 percent slopes. Bedded shale is at a depth of about 28 inches. Depth is marked in feet.

Bk horizon:
Hue—2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 to 4
Texture—silty clay

C horizon:
Hue—2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 to 4
Texture—silty clay or clay

Cr horizon:
Hue—2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 or 3
Kind of bedrock—shale

In some pedons the underlying bedded shale has varying amounts of gypsum, other salts, and carbonates in seams.

Lohmiller Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Slow
Landform: Flood plains
Parent material: Calcareous, clayey alluvium
Slope: 0 to 2 percent

Typical Pedon

Lohmiller silty clay, channeled (fig. 13), 1,412 feet north and 1,244 feet east of the southwest corner of sec. 1, T. 6 N., R. 19 E.

A—0 to 4 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak thin platy and weak medium subangular blocky structure; slightly hard, friable; many roots; slight effervescence; moderately alkaline; clear wavy boundary.

C1—4 to 16 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak thin platy and weak coarse subangular blocky structure; slightly hard, friable; thin bedding planes; many roots; strong effervescence; slightly alkaline; gradual wavy boundary.

C2—16 to 60 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable; thin bedding planes; common roots to a depth of 36 inches and few roots to a depth of 45 inches; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 7 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: More than 60 inches

Figure 13.—Profile of Lohmiller silty clay, channeled. Stratification begins at a depth of about 4 inches. Depth is marked in feet.

A horizon:
Hue—10YR or 2.5Y; value—5 or 6 (4 or 5 moist); and chroma—2 to 4
Texture—dominantly silty clay but silty clay loam in some pedons

C horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 to 4
Texture—silty clay or clay loam

Midway Series

Depth to bedrock: Shallow
Drainage class: Well drained
Permeability: Slow
Landform: Dissected plains
Parent material: Calcareous, clayey residuum
Slope: 6 to 40 percent

Typical Pedon

Midway silty clay loam, 15 to 40 percent slopes, 20 feet west and 1,236 feet north of the southeast corner of sec. 25, T. 1 N., R. 18 E.

A—0 to 4 inches; light olive brown (2.5Y 5/4) silty clay loam, olive brown (2.5Y 4/4) moist; weak fine granular and subangular blocky structure; slightly hard, friable, sticky and slightly plastic; many roots; strong effervescence; slightly alkaline; clear wavy boundary.

AC—4 to 8 inches; light olive brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; many roots; strong effervescence; moderately alkaline; gradual wavy boundary.

C—8 to 13 inches; light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; massive; slightly hard, friable, sticky and slightly plastic; many roots; strong effervescence; moderately alkaline; clear wavy boundary.

Cr1—13 to 30 inches; light yellowish brown (2.5Y 6/4) shale, light olive brown (2.5Y 5/4) moist; common roots to a depth of 26 inches; slight effervescence; moderately alkaline; clear wavy boundary.

Cr2—30 to 60 inches; light gray (2.5Y 7/1) and light yellowish brown (2.5Y 6/4) shale, gray (2.5Y 5/1) and light olive brown (2.5Y 5/4) moist; slight effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 3 inches
Depth to contrasting parent material: 10 to 20 inches over shale bedrock
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR or 2.5Y; value—4 to 6 (3 to 5 moist); and chroma—2 to 4
Texture—dominantly silty clay loam but silty clay in some pedons

C horizon:
Hue—10YR or 2.5Y; value—6 or 7 (5 or 6 moist); and chroma—2 or 4
Texture—clay, clay loam, or silty clay loam

Cr horizon:
Hue—10YR or 2.5Y; value—6 or 7 (5 or 6 moist); and chroma—2 to 4
Kind of bedrock—shale

Mosher Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Very slow
Landform: Terraces
Parent material: Loamy alluvium
Slope: 0 to 6 percent

Typical Pedon

Mosher silt loam, in an area of Kirley-Mosher complex, 0 to 2 percent slopes, 920 feet north and 100 feet west of the southeast corner of sec. 12, T. 1 N., R. 21 E.

A—0 to 3 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; many roots; neutral; clear smooth boundary.

E—3 to 6 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak thin platy structure; soft, very friable; many roots; neutral; abrupt smooth boundary.

Btn1—6 to 10 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; strong medium columnar structure; very hard, firm, sticky and plastic; shiny films on faces of peds; many roots; moderately alkaline; clear smooth boundary.

Btn2—10 to 18 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; strong medium prismatic structure; very hard, firm, sticky and plastic; shiny films on faces of peds; common roots; moderately alkaline; gradual wavy boundary.

Bkz—18 to 26 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common roots; few fine accumulations of carbonate; common fine threads of salts; strong effervescence; moderately alkaline; gradual wavy boundary.

C—26 to 60 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; hard, friable; few roots to a depth of 40 inches; moderately alkaline; strong effervescence.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 20 inches
Depth to carbonates: 10 to 20 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: 16 to 30 inches

A horizon:
Hue—10YR; value—4 or 5 (2 or 3 moist); and chroma—1 or 2
Texture—dominantly silt loam but loam in some pedons

E horizon:
Hue—10YR; value—5 to 7 (3 or 4 moist); and chroma—1 or 2
Texture—silt loam

Btn horizon:
Hue—10YR; value—3 to 5 (2 to 4 moist); and chroma—1 or 2
Texture—clay

Bkz horizon:
Hue—10YR or 2.5Y; value—5 or 6 (4 or 5 moist); and chroma—1 to 3
Texture—clay loam or clay

C horizon:
Hue—10YR or 2.5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—loam or clay loam

Nihill Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Terraces
Parent material: Gravelly alluvium
Slope: 6 to 40 percent

Typical Pedon

Nihill gravelly loam, in an area of Nunn-Nihill complex, 6 to 15 percent slopes, 1,320 feet north and 2,577 feet east of the southwest corner of sec. 26, T. 1 S., R. 18 E. (from Jackson County, South Dakota):

A—0 to 9 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist, dark grayish brown (10YR 4/2) crushed; weak fine granular

structure; slightly hard, friable; common roots; about 36 percent gravel; strong effervescence; slightly alkaline; gradual wavy boundary.

C—9 to 60 inches; pale yellow (2.5Y 7/4) very gravelly loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, friable; few roots in the upper part; about 40 percent gravel; carbonates on the underside of pebbles in the upper part; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 2 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR or 2.5Y; value—4 to 6 (3 to 5 moist); and chroma—2 or 3
Texture—gravelly loam

C horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 or 3
Texture—very gravelly loam or very gravelly clay loam

Nimbro Series

Depth to bedrock: Very deep
Drainage class: Well drained

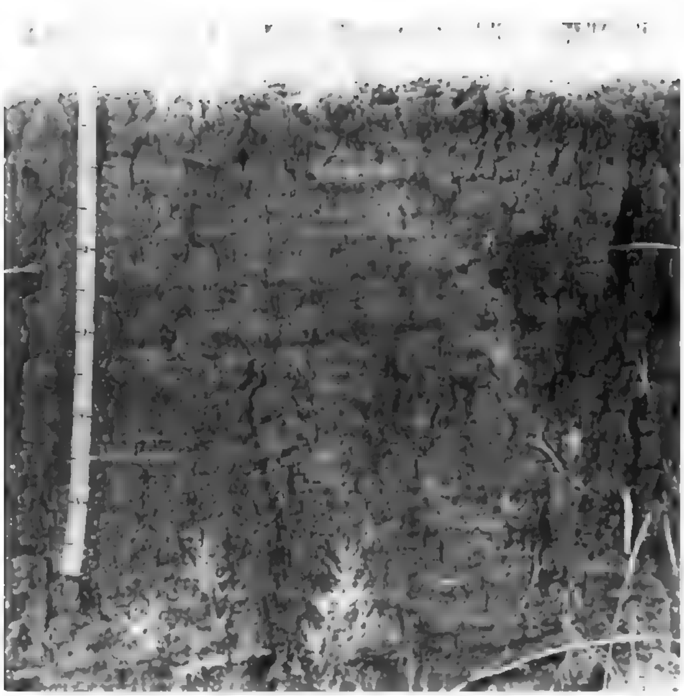

Figure 14.—Profile of Nimbro silty clay loam. Stratification begins at a depth of about 8 inches. Depth is marked in feet.

Permeability: Moderate
Landform: Flood plains
Parent material: Calcareous, loamy alluvium
Slope: 0 to 2 percent

Typical Pedon

Nimbro silty clay loam (fig. 14), 1,513 feet west and 336 feet south of the northeast corner of sec. 12, T. 1 N., R. 24 E.

Ap—0 to 8 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; common roots; slight effervescence; slightly alkaline; abrupt smooth boundary.

C1—8 to 15 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, very friable; common roots; strong effervescence; slightly alkaline; clear wavy boundary.

C2—15 to 50 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable; common roots in the upper part and few roots in the lower part; strong effervescence; moderately alkaline; abrupt wavy boundary.

Cyz—50 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, very friable; many fine masses and striations of gypsum and other salts; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 3 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR or 2.5Y; value—4 or 5 (2 or 3 moist); and chroma—1 or 2
Texture—dominantly silty clay loam but loam in some pedons

C horizon:
Hue—10YR or 2.5Y; value—4 to 7 (3 to 5 moist); and chroma—2 to 4
Texture—silty clay loam or clay loam

The Nimbro soils in this county contain less sand than is defined as the range for the series. This difference, however, does not significantly alter the usefulness or behavior of the soils.

Nunn Series

Depth to bedrock: Very deep
Drainage class: Well drained

Permeability: Moderately slow
Landform: Terraces
Parent material: Calcareous, loamy alluvium
Slope: 0 to 15 percent

Typical Pedon

Nunn loam, 0 to 2 percent slopes, 1,670 feet east and 200 feet north of the southwest corner of sec. 30, T. 1 N., R. 23 E.

Ap—0 to 5 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak fine granular; slightly hard, friable; many roots; neutral; abrupt wavy boundary.

Bt1—5 to 12 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to moderate medium and coarse subangular blocky; hard, firm, sticky and plastic; shiny films on faces of peds; many roots; neutral; gradual wavy boundary.

Bt2—12 to 26 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate coarse prismatic structure parting to strong medium subangular blocky; very hard, firm, sticky and plastic; shiny films on faces of peds; many roots; neutral; clear wavy boundary.

Bk1—26 to 33 inches; light olive brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3) moist; moderate coarse and medium subangular blocky structure; very hard, friable, sticky; common roots; many fine accumulations of carbonate; strong effervescence; slightly alkaline; gradual wavy boundary.

Bk2—33 to 37 inches; light olive brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3) moist; weak coarse subangular blocky structure; slightly hard, very friable, sticky; few roots; many large accumulations of carbonate; strong effervescence; slightly alkaline; gradual wavy boundary.

C—37 to 60 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; massive; slightly hard, very friable, sticky; many fine accumulations of carbonate; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 18 inches
Depth to carbonates: 12 to 20 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR or 2.5Y; value—4 or 5 (2 or 3 moist); and chroma—1 or 2
Texture—dominantly loam but clay loam in some pedons

Bt horizon:
Hue—10YR or 2.5Y; value—4 or 5 (3 or 4 moist); and chroma—2 or 3
Texture—clay or clay loam

Bk horizon:
Hue—10YR or 2.5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—clay loam

C horizon:
Hue—10YR or 2.5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—clay loam

Okaton Series

Depth to bedrock: Shallow
Drainage class: Well drained
Permeability: Slow
Landform: Dissected plains
Parent material: Clayey residuum
Slope: 15 to 40 percent

Typical Pedon

Okaton silty clay, in an area of Okaton-Lakoma silty clays, 15 to 40 percent slopes, 2,607 feet west and 2,272 feet north of the southeast corner of sec. 27, T. 7 N., R. 24 E.

A—0 to 4 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; weak fine granular and subangular blocky structure; slightly hard, friable, slightly sticky; many roots; slight effervescence; slightly alkaline; clear smooth boundary.

AC—4 to 9 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; many roots; about 10 percent fragments of shale; strong effervescence; slightly alkaline; clear wavy boundary.

C—9 to 14 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, sticky and slightly plastic; common roots; about 50 percent fragments of shale; strong effervescence; slightly alkaline; clear wavy boundary.

Cr—14 to 60 inches; light brownish gray (2.5Y 6/2) and pale yellow (2.5Y 7/4) shale, grayish brown (2.5Y 5/2) and light yellowish brown (2.5Y 6/4) moist; massive; common roots to a depth of 24 inches and few roots to a depth of 30 inches; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 2 inches
Depth to contrasting parent material: 10 to 20 inches over shale bedrock
Depth to gypsum and other visible salts: 8 to more than 60 inches

A horizon:
Hue—10YR or 2.5Y; value—5 to 7 (3 to 5 moist); and chroma—2 to 4
Texture—dominantly silty clay but clay in some pedons

C horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 to 3
Texture—silty clay

Cr horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 or 3
Kind of bedrock—shale

In some pedons the underlying bedded shale has varying amounts of gypsum, other salts, and carbonates in seams.

Onita Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Terraces
Parent material: Clayey alluvium
Slope: 0 to 2 percent

Typical Pedon

Onita silt loam, 150 feet east and 2,565 feet north of the southwest corner of sec. 10, T. 6 N., R. 20 E.

Ap—0 to 5 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, very friable; many roots; neutral; abrupt smooth boundary.

A—5 to 12 inches; dark gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; slightly hard, very friable; many roots; neutral; clear wavy boundary.

Bt1—12 to 16 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky; shiny films on faces of peds; many roots; neutral; clear wavy boundary.

Bt2—16 to 30 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to strong medium blocky; hard, friable, slightly sticky and plastic; shiny films on faces of peds; many roots to a depth of 24 inches and common roots to a depth of 30 inches; neutral; gradual wavy boundary.

Bt3—30 to 37 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure; hard, friable, slightly sticky and plastic; shiny films on faces of peds; common roots; moderately alkaline; clear wavy boundary.

Bk—37 to 49 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; slightly hard, very friable; few roots; many fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C—49 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, very friable; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 20 to 40 inches
Depth to carbonates: 25 to 40 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR; value—3 to 5 (2 or 3 moist); and chroma—1 or 2
Texture—dominantly silt loam but silty clay loam or loam in some pedons

Bt horizon:
Hue—10YR or 2.5Y; value—3 to 5 (2 to 4 moist); and chroma—1 or 2
Texture—silty clay or silty clay loam

Bk horizon:
Hue—10YR or 2.5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—silty clay or silty clay loam

C horizon:
Hue—10YR or 2.5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—silty clay loam

Opal Series

Depth to bedrock: Moderately deep
Drainage class: Well drained
Permeability: Very slow
Landform: Dissected plains

Parent material: Clayey residuum
Slope: 3 to 25 percent

Typical Pedon

Opal clay (fig. 15), in an area of Opal-Promise clays, 3 to 6 percent slopes, 773 feet east and 470 feet north of the southwest corner of sec. 28, T. 6 N., R. 22 E.

Ap1—0 to 3 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, friable, sticky and plastic; many roots; slight effervescence; slightly alkaline; abrupt smooth boundary.

Ap2—3 to 6 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; weak medium subangular blocky and weak fine granular structure; hard, firm, sticky and plastic; many roots; slight effervescence; slightly alkaline; abrupt smooth boundary.

Bss1—6 to 14 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; weak coarse subangular blocky structure; extremely hard, very firm, sticky and plastic; common roots; cracks 0.5 inch wide; few faint nonintersecting slickensides, which are tilted 40 degrees from horizontal; strong effervescence; slightly alkaline; gradual wavy boundary.

Bss2—14 to 26 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate coarse subangular blocky structure; extremely hard, very firm, sticky and plastic; few roots; cracks 0.5 inch wide; common prominent intersecting slickensides, which are tilted 35 degrees from horizontal; strong effervescence; slightly alkaline; gradual wavy boundary.

Bkss—26 to 33 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate coarse subangular blocky structure; extremely hard, very firm, sticky and plastic; few roots; cracks 0.25 inch wide; common prominent intersecting slickensides, which are tilted 35 degrees from horizontal; few medium and fine accumulations of carbonate; strong effervescence; slightly alkaline; clear wavy boundary.

C—33 to 36 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; massive; hard, firm, sticky and plastic; few fine accumulations of carbonate; about 45 percent fragments of shale; slight effervescence; slightly alkaline; clear wavy boundary.

Cr—36 to 60 inches; light brownish gray (2.5Y 6/2) shale, grayish brown (2.5Y 5/2) moist; massive; few fine masses of gypsum and other salts between shale plates; slightly alkaline.

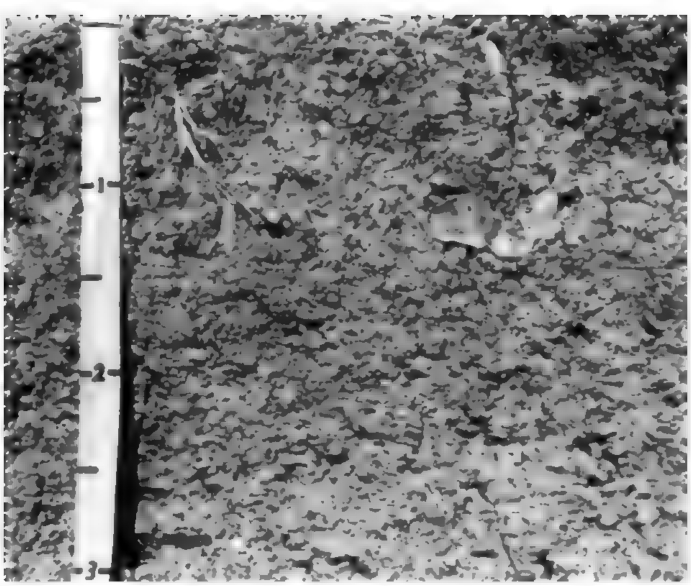

Figure 15.—Profile of Opal clay. Bedded shale is at a depth of about 36 inches. Depth is marked in feet.

Range in Characteristics

Depth to carbonates: 0 to 7 inches
Depth to contrasting parent material: 20 to 40 inches over shale bedrock
Depth to gypsum and other visible salts: 20 to more than 60 inches

A horizon:
Hue—10YR or 2.5Y; value—4 or 5 (2 or 3 moist); and chroma—1 or 2
Texture—dominantly clay but silty clay or clay loam in some pedons

Bss horizon:
Hue—2.5Y or 5Y; value—4 to 6 (2 to 4 moist); and chroma—2 or 3
Texture—clay

Bk horizon:
Hue—2.5Y or 5Y; value—4 to 6 (3 to 5 moist); and chroma—2 to 4
Texture—clay

C horizon:
Hue—2.5Y or 5Y; value—5 or 6 (4 or 5 moist); and chroma—1 to 3
Texture—clay

Cr horizon:
Hue—2.5Y or 5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Kind of bedrock—shale

In some pedons the underlying bedded shale has varying amounts of gypsum, other salts, and carbonates in seams.

Ottumwa Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Slow
Landform: Plains
Parent material: Clayey residuum
Slope: 0 to 9 percent

Typical Pedon

Ottumwa silty clay, 3 to 6 percent slopes, 1,215 feet north and 160 feet west of the southeast corner of sec. 9, T. 4 N., R. 19 E.

A1—0 to 2 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable, sticky and plastic; neutral; abrupt smooth boundary.

A2—2 to 6 inches; dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; neutral; clear smooth boundary.

Bw—6 to 15 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; weak medium and coarse prismatic structure parting to moderate medium and fine subangular blocky; very hard, very firm, sticky and plastic; slight effervescence; moderately alkaline; clear wavy boundary.

Bss—15 to 26 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; very hard, very firm, sticky and plastic; tongues and streaks of very dark grayish brown (2.5Y 3/2) material; few distinct nonintersecting slickensides, which are tilted 10 to 15 degrees from horizontal; strong effervescence; moderately alkaline; clear wavy boundary.

Bkss—26 to 39 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; very hard, very firm, sticky and plastic; few distinct intersecting slickensides, which are tilted 10 to 15 degrees from horizontal; few fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

Bkyz—39 to 51 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; weak medium and coarse subangular blocky structure; hard, firm, sticky and plastic; few fine prominent yellowish brown (10YR 5/6) iron stains; many fine and few medium accumulations of carbonate; common medium masses of gypsum and other salts; strong effervescence; slightly alkaline; gradual wavy boundary.

Cyz—51 to 60 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, sticky and plastic; few fine prominent yellowish brown (10YR 5/6) and brown (7.5YR 4/4) iron stains; few fine accumulations of carbonate; few fine masses of gypsum and other salts; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 20 inches
Depth to carbonates: 0 to 8 inches
Depth to contrasting parent material: 40 to more than 60 inches over shale bedrock
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—2.5Y or 5Y; value—4 or 5 (2 or 3 moist); and chroma—1 or 2
Texture—dominantly silty clay but clay in some pedons

Bw and Bss horizons:
Hue—2.5Y or 5Y; value—4 to 6 (3 or 4 moist); and chroma—2 or 3
Texture—silty clay or clay

Bk horizon:
Hue—2.5Y or 5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—silty clay or clay

C horizon:
Hue—2.5Y or 5Y; value—5 to 7 (4 to 6 moist); and chroma—2 or 3
Texture—silty clay or clay

Some pedons have a Cr horizon of shale below a depth of 40 inches.

Pierre Series

Depth to bedrock: Moderately deep
Drainage class: Well drained
Permeability: Very slow
Landform: Dissected plains
Parent material: Clayey residuum
Slope: 6 to 25 percent

Typical Pedon

Pierre clay, 6 to 9 percent slopes, 560 feet north and 1,300 feet east of the southwest corner of sec. 30, T. 3 N., R. 21 E.

A—0 to 2 inches; grayish brown (2.5Y 5/2) clay, dark

grayish brown (2.5Y 4/2) moist; moderate fine subangular blocky structure parting to weak very fine granular; hard, firm, sticky and plastic; many fine and medium roots; cracks 0.75 inch wide; 1 percent pebbles; slight effervescence; moderately alkaline; clear smooth boundary.

ABss—2 to 7 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak medium blocky structure; very hard, very firm, very sticky and very plastic; common fine and medium roots between peds and few fine roots throughout; cracks 0.75 inch wide; common distinct nonintersecting slickensides, which are tilted 20 degrees from horizontal; 1 percent pebbles; strong effervescence; moderately alkaline; clear wavy boundary.

Bss—7 to 20 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium and coarse prismatic structure; extremely hard, very firm, very sticky and very plastic; few fine roots between peds; cracks 0.50 inch wide; common distinct intersecting slickensides, which are tilted 30 to 40 degrees from horizontal; few fine accumulations of iron; 1 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

Bssy—20 to 27 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure; extremely hard, very firm, very sticky and very plastic; few fine roots between peds; cracks 0.25 inch wide; common distinct intersecting slickensides; few fine nests of iron; many fine accumulations of gypsum; 1 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

Cr1—27 to 40 inches; light brownish gray (2.5Y 6/2), soft shale, dark grayish brown (2.5Y 4/2) moist; common prominent strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) iron stains; many fine accumulations of gypsum and carbonate; 1 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

Cr2—40 to 60 inches; light olive gray (5Y 6/2), soft shale, olive gray (5Y 5/2) moist; common distinct strong brown (7.5YR 5/6) iron stains; 1 percent pebbles; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 6 inches
Depth to contrasting parent material: 20 to 40 inches over shale bedrock
Depth to gypsum and other visible salts: 20 to more than 60 inches

A horizon:
Hue—10YR, 2.5Y, or 5Y; value—4 to 6 (3 to 5 moist); and chroma—1 to 3
Texture—dominantly clay but silty clay in some pedons

Bss horizon:
Hue—2.5Y or 5Y; value—5 or 6 (4 or 5 moist); and chroma—1 to 3
Texture—clay

Cr horizon:
Hue—2.5Y or 5Y; value—5 to 7 (4 to 6 moist); and chroma—2 to 4
Kind of bedrock—shale

In some pedons the underlying bedded shale has varying amounts of gypsum, other salts, and carbonates in seams.

Promise Series

Depth to bedrock: Deep and very deep
Drainage class: Well drained
Permeability: Very slow
Landform: Plains
Parent material: Clayey residuum
Slope: 0 to 6 percent

Typical Pedon

Promise clay, 0 to 3 percent slopes, 1,513 feet east and 2,490 feet south of the northwest corner of sec. 24, T. 4 N., R. 22 E.

Ap—0 to 5 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; weak fine subangular blocky and moderate fine granular structure; slightly hard, friable, sticky and plastic; many roots; slightly alkaline; abrupt smooth boundary.

Bss1—5 to 8 inches; grayish brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate fine blocky structure; hard, firm, sticky and plastic; many roots; cracks 0.75 inch wide; few prominent intersecting slickensides, which are tilted 30 degrees from horizontal; slight effervescence; slightly alkaline; clear smooth boundary.

Bss2—8 to 19 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate coarse blocky structure; very hard, firm, sticky and plastic; common roots; common prominent intersecting slickensides, which are tilted 30 degrees from horizontal and are 1 to 4 inches wide; strong effervescence; moderately alkaline; clear wavy boundary.

Bkss1—19 to 25 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate coarse blocky structure; very hard, firm, sticky and plastic; many prominent intersecting slickensides, which are tilted 35 degrees from horizontal; few medium

accumulations of carbonate; common roots; strong effervescence; slightly alkaline; clear wavy boundary.

Bkss2—25 to 29 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; extremely hard, very firm, sticky and plastic; few roots; common distinct nonintersecting slickensides, which are tilted 35 degrees from horizontal; strong effervescence; slightly alkaline; clear wavy boundary.

Cyz1—29 to 40 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; extremely hard, firm, slightly sticky and plastic; common masses of gypsum and other salts; strong effervescence; slightly alkaline; gradual wavy boundary.

Cyz2—40 to 60 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; very hard, firm, slightly sticky and plastic; few masses of gypsum and other salts; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Depth to contrasting parent material: 40 to more than 60 inches over shale bedrock
Depth to gypsum and other visible salts: 25 to 45 inches

A horizon:
Hue—10YR or 2.5Y; value—4 or 5 (2 or 3 moist); and chroma—1 or 2
Texture—dominantly clay but silty clay in some pedons

Bss horizon:
Hue—2.5Y or 5Y; value—4 to 6 (2 to 4 moist); and chroma—2 to 3
Texture—clay

Bk horizon:
Hue—2.5Y or 5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—clay

Cyz horizon:
Hue—2.5Y or 5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—clay or silty clay

Razor Series

Depth to bedrock: Moderately deep
Drainage class: Well drained
Permeability: Slow
Landform: Dissected plains
Parent material: Clayey residuum
Slope: 2 to 25 percent

Typical Pedon

Razor silty clay, in an area of Razor-Midway complex, 6 to 15 percent slopes, 600 feet east and 1,100 feet south of the northwest corner of sec. 36, T. 4 N., R. 18 E.

A—0 to 4 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure parting to weak fine and medium granular; slightly hard, friable; many roots; neutral; clear smooth boundary.

Bw—4 to 14 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; common roots; slightly alkaline; clear wavy boundary.

BCk—14 to 29 inches; light olive brown (2.5Y 5/4) and light brownish gray (2.5Y 6/2) silty clay, olive brown (2.5Y 4/4) and grayish brown (2.5Y 5/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm, sticky and plastic; common roots; common fine and medium accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

Cr—29 to 60 inches; light yellowish brown (2.5Y 6/4) shale, light olive brown (2.5Y 5/4) moist; violent effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 19 inches
Depth to contrasting parent material: 20 to 40 inches over shale bedrock
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—2.5Y; value—5 or 6 (4 or 5 moist); and chroma—2 to 4
Texture—dominantly silty clay but silty clay loam or clay in some pedons

Bw horizon:
Hue—2.5Y; value—5 or 6 (4 or 5 moist); and chroma—2 to 4
Texture—silty clay or clay

Cr horizon:
Hue—2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 to 4
Kind of bedrock—shale

Ree Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderate

Landform: Terraces
Parent material: Loamy alluvium
Slope: 0 to 9 percent

Typical Pedon

Ree loam, 0 to 2 percent slopes, 1,540 feet south and 1,800 feet east of the northwest corner of sec. 10, T. 6 N., R. 19 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine and medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; many roots; neutral; abrupt smooth boundary.

Bt1—8 to 16 inches; grayish brown (2.5Y 5/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; weak medium and fine prismatic structure parting to moderate medium and fine subangular blocky; hard, friable, slightly sticky; shiny films on faces of peds; many roots; neutral; clear smooth boundary.

Bt2—16 to 21 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky; shiny films on faces of peds; common roots; slightly alkaline; clear wavy boundary.

Bk1—21 to 38 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak medium and coarse prismatic structure parting to weak medium and coarse subangular blocky; hard, friable; common medium and fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

Bk2—38 to 45 inches; light brownish gray (2.5Y 6/2) sandy loam, grayish brown (2.5Y 5/2) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable; few roots; few medium and fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C—45 to 60 inches; light brownish gray (2.5Y 6/2) loamy sand, grayish brown (2.5Y 5/2) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 20 inches
Depth to carbonates: 12 to 30 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR; value—3 to 5 (2 or 3 moist); and chroma—1 or 2
Texture—dominantly loam but silt loam in some pedons

Bt horizon:
Hue—10YR or 2.5Y; value—4 or 5 (3 or 4 moist); and chroma—1 to 3
Texture—clay loam, silty clay loam, or sandy loam

Bk horizon:
Hue—10YR or 2.5Y; value—5 or 6 (4 or 5 moist); and chroma—2 or 3
Texture—loam, clay loam, or fine sandy loam

C horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 to 4
Texture—dominantly loamy sand, sandy loam, loam, or clay loam but sand or silt loam in some pedons

Samsil Series

Depth to bedrock: Shallow
Drainage class: Well drained
Permeability: Slow
Landform: Dissected plains
Parent material: Clayey residuum
Slope: 6 to 60 percent

Typical Pedon

Samsil clay, 25 to 60 percent slopes, 2,072 feet east and 1,537 feet south of the northwest corner of sec. 21, T. 7 N., R. 20 E.

A—0 to 4 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak fine subangular blocky structure parting to weak fine granular; hard, friable, sticky and plastic; common roots; slight effervescence; slightly alkaline; clear wavy boundary.

AC—4 to 8 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; common roots; about 15 percent fragments of shale; slight effervescence; slightly alkaline; clear wavy boundary.

C—8 to 14 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky and plastic; common roots; about 50 percent fragments of shale; strong effervescence; slightly alkaline; clear wavy boundary.

Cr—14 to 60 inches; light brownish gray (2.5Y 6/2) shale, dark grayish brown (2.5Y 4/2) moist; can be easily dug by a spade but has plates that are hard and brittle when dry; few roots to a depth of 36 inches; slight effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 3 inches
Depth to contrasting parent material: 10 to 20 inches over shale bedrock
Depth to gypsum and other visible salts: 10 to more than 60 inches

A horizon:
Hue—10YR, 2.5Y, or 5Y; value—5 to 7 (3 to 5 moist); and chroma—2 to 4
Texture—dominantly clay but silty clay in some pedons

AC horizon:
Hue—2.5Y or 5Y; value—5 to 7 (3 to 5 moist); and chroma—2 to 4
Texture—clay

C horizon:
Hue—2.5Y or 5Y; value—5 to 7 (3 to 5 moist); and chroma—1 to 4
Texture—clay

Cr horizon:
Hue—2.5Y or 5Y; value—5 to 7 (3 to 5 moist); and chroma—1 to 4
Kind of bedrock—shale

In some pedons, the underlying material (C horizon) has varying amounts of gypsum, other salts, and carbonates and the underlying bedded shale (Cr horizon) has varying amounts of gypsum, other salts, and carbonates in seams.

Sansarc Series

Depth to bedrock: Shallow
Drainage class: Well drained
Permeability: Slow
Landform: Dissected plains
Parent material: Clayey residuum
Slope: 2 to 60 percent

Typical Pedon

Sansarc clay, in an area of Sansarc-Opal clays, 9 to 40 percent slopes, 1,177 feet west and 2,287 feet north of the southeast corner of sec. 7, T. 1 N., R. 25 E.

A—0 to 4 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate fine granular and weak medium subangular blocky structure; hard, friable, sticky and plastic; many roots; slight effervescence; slightly alkaline; clear wavy boundary.

AC—4 to 8 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; hard, friable, sticky and plastic; many roots; about 30 percent fragments of shale; strong effervescence; slightly alkaline; gradual wavy boundary.

C—8 to 15 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; massive; loose, very friable; common light brownish gray (2.5Y 6/2) iron stains; common roots; about 40 percent fragments of shale; slight effervescence; slightly alkaline; gradual wavy boundary.

Cr—15 to 60 inches; light brownish gray (2.5Y 6/2) shale, grayish brown (2.5Y 5/2) moist; can be easily dug by a spade but has plates that are hard and brittle when dry; many pale yellow (2.5Y 7/4) iron stains; few roots to a depth of 25 inches; slight effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 3 inches
Depth to contrasting parent material: 10 to 20 inches over shale bedrock
Depth to gypsum and other visible salts: 10 to more than 60 inches

A horizon:
Hue—10YR, 2.5Y, or 5Y; value—4 to 6 (3 to 5 moist); and chroma—1 or 2
Texture—dominantly clay but silty clay in some pedons

AC horizon:
Hue—2.5Y or 5Y; value—5 to 7 (4 to 6 moist); and chroma—1 or 2
Texture—clay

C horizon:
Hue—2.5Y or 5Y; value—5 to 7 (4 to 6 moist); and chroma—1 or 2
Texture—clay

Cr horizon:
Hue—2.5Y or 5Y; value—5 to 7 (4 to 6 moist); and chroma—1 or 2
Kind of bedrock—shale

In some pedons the underlying bedded shale has many seams of gypsum, other salts, and carbonates.

Savo Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Plains
Parent material: Clayey residuum
Slope: 0 to 9 percent

Typical Pedon

Savo silt loam, 2 to 6 percent slopes, 470 feet west and 2,085 feet south of the northeast corner of sec. 26, T. 4 N., R. 18 E.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; many roots; slightly acid; abrupt smooth boundary.

Bt1—6 to 13 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; shiny films on faces of peds; many roots; neutral; clear wavy boundary.

Bt2—13 to 20 inches; light olive brown (2.5Y 5/3) silty clay loam, olive brown (2.5Y 4/3) moist; moderate medium and coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; shiny films on faces of peds; common roots; neutral; clear wavy boundary.

Bk1—20 to 35 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; slightly hard, friable, sticky and plastic; few roots; common fine accumulations of carbonate; violent effervescence; slightly alkaline; gradual wavy boundary.

Bk2—35 to 45 inches; light yellowish brown (2.5Y 6/3) silty clay loam, light olive brown (2.5Y 5/3) moist; weak coarse subangular blocky structure; slightly hard, friable, sticky and plastic; many fine accumulations of carbonate; violent effervescence; slightly alkaline; gradual wavy boundary.

Bk3—45 to 60 inches; light yellowish brown (2.5Y 6/3) silty clay loam, light olive brown (2.5Y 5/3) moist; weak coarse subangular blocky structure; slightly hard, friable, sticky and plastic; many fine accumulations of carbonate; violent effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 15 inches
Depth to carbonates: 15 to 20 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR; value—4 or 5 (2 or 3 moist); and chroma—1 or 2
Texture—dominantly silt loam but silty clay loam in some pedons

Bt horizon:
Hue—10YR or 2.5Y; value—4 or 5 (2 to 4 moist); and chroma—1 or 2
Texture—silty clay loam, clay loam, or silty clay

Bk horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 or 3
Texture—silty clay loam, clay loam, or silt loam

Some pedons have a C horizon.

Schamber Series

Depth to bedrock: Very deep
Drainage class: Somewhat excessively drained
Permeability: Rapid
Landform: Terraces
Parent material: Gravelly outwash
Slope: 6 to 60 percent

Typical Pedon

Schamber gravelly loam, in an area of Schamber-Samsil complex, 6 to 60 percent slopes, 320 feet south and 1,520 feet west of the northeast corner of sec. 1, T. 6 N., R. 20 E.

A—0 to 6 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; loose; about 20 percent gravel by volume; slightly acid; clear smooth boundary.

C1—6 to 42 inches; pale brown (10YR 6/3) very gravelly sand, brown (10YR 5/3) moist; single grain; loose; about 40 percent gravel by volume; slight effervescence; slightly alkaline; gradual wavy boundary.

C2—42 to 60 inches; pale brown (10YR 6/3) very gravelly sand, brown (10YR 5/3) moist; single grain; loose; strong effervescence; about 50 percent gravel by volume; slightly alkaline.

Range in Characteristics

Depth to carbonates: 2 to 8 inches
Depth to contrasting parent material: 4 to 10 inches over sand and gravel
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR; value—4 to 6 (3 to 5 moist); and chroma—2 to 4
Texture—dominantly gravelly loam but gravelly sandy loam in some pedons

C horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 to 4
Texture—very gravelly sand or very gravelly loamy sand

Shingle Series

Depth to bedrock: Shallow
Drainage class: Well drained
Permeability: Moderate in the upper part of the profile and slow in the lower part
Landform: Dissected plains
Parent material: Loamy residuum
Slope: 6 to 40 percent

Typical Pedon

Shingle silty clay loam, in an area of Shingle-Razor complex, 15 to 25 percent slopes, 702 feet west and 200 feet north of the southeast corner of sec. 20, T. 4 N., R. 18 E.

A—0 to 4 inches; light olive brown (2.5Y 5/3) silty clay loam, olive brown (2.5Y 4/3) moist; weak fine granular structure; slightly hard, very friable; many roots; slight effervescence; slightly alkaline; clear smooth boundary.
AC—4 to 9 inches; light olive brown (2.5Y 5/3) silty clay loam, olive brown (2.5Y 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable; many roots; disseminated carbonates; strong effervescence; slightly alkaline; gradual wavy boundary.
C—9 to 17 inches; light yellowish brown (2.5Y 6/4) silty clay loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, very friable; common roots; disseminated carbonates; about 15 percent fragments of shale; strong effervescence; slightly alkaline; clear wavy boundary.
Cr—17 to 60 inches; light yellowish brown (2.5Y 6/4) shale, light olive brown (2.5Y 5/4) moist; many yellowish brown (10YR 5/6) iron stains; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 2 inches
Depth to contrasting parent material: 10 to 20 inches over shale bedrock
Depth to gypsum and other visible salts: More than 60 inches

A horizon:
Hue—10YR or 2.5Y; value—5 to 7 (3 to 6 moist); and chroma—2 to 5
Texture—dominantly silty clay loam but clay loam, silt loam, or loam in some pedons

C horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 to 5
Texture—silty clay loam or clay loam

Cr horizon:
Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 to 5
Kind of bedrock—shale

Vivian Series

Depth to bedrock: Deep
Drainage class: Somewhat excessively drained
Permeability: Moderately rapid in the upper part of the profile and very slow in the lower part
Landform: Terraces
Parent material: Outwash over shale bedrock
Slope: 6 to 25 percent

Typical Pedon

Vivian gravelly loam, in an area of Lakoma-Vivian complex, 9 to 25 percent slopes, 2,490 feet east and 30 feet north of the southwest corner of sec. 12, T. 1 N., R. 25 E.

A—0 to 3 inches; grayish brown (10YR 5/2) gravelly loam, dark grayish brown (10YR 4/2) moist; weak medium granular structure; soft, very friable; about 20 percent gravel by volume; strong effervescence; slightly alkaline; clear smooth boundary.
AC—3 to 10 inches; light olive brown (2.5Y 5/3) gravelly loam, olive brown (2.5Y 4/3) moist; weak medium subangular blocky structure; soft, friable; about 25 percent gravel by volume; strong effervescence; slightly alkaline; clear wavy boundary.
C—10 to 50 inches; light yellowish brown (2.5Y 6/3) very gravelly loam, olive brown (2.5Y 4/3) moist; massive; loose; about 40 percent gravel by volume; violent effervescence; slightly alkaline; abrupt smooth boundary.
2Cr—50 to 60 inches; light brownish gray (2.5Y 6/2) shale, grayish brown (2.5Y 5/2) moist; brittle; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 4 inches
Depth to contrasting parent material: 40 to 60 inches over shale bedrock
Depth to gypsum and other visible salts: More than 60 inches

A horizon:

Hue—10YR or 2.5Y; value—4 to 6 (4 or 5 moist); and chroma—2 to 4

Texture—dominantly gravelly loam but gravelly clay loam, loam, or very gravelly loam in some pedons

C horizon:

Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 to 4

Texture—dominantly very gravelly loam but very gravelly clay loam, very gravelly fine sandy loam, or extremely gravelly loam in some pedons

2Cr horizon:

Hue—2.5Y; value—6 or 7 (5 or 6 moist); and chroma—2 to 4

Kind of bedrock—shale

Wanblee Series

Depth to bedrock: Moderately deep
Drainage class: Moderately well drained
Permeability: Very slow
Landform: Plains
Parent material: Silty residuum derived from siltstone bedrock
Slope: 0 to 2 percent

Typical Pedon

Wanblee silt loam, in an area of Wortman-Wanblee silt loams, 0 to 2 percent slopes, 2,506 feet east and 1,905 feet north of the southwest corner of sec. 22, T. 3 N., R. 18 E.

E—0 to 2 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak thin platy structure; soft, very friable; many roots; neutral; abrupt smooth boundary.

Btn1—2 to 5 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium columnar structure parting to strong medium subangular blocky; extremely hard, firm, slightly sticky and plastic; shiny films on faces of peds; many roots; neutral; clear wavy boundary.

Btn2—5 to 9 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; very hard, firm, slightly sticky and plastic; shiny films on faces of peds; many roots; moderately alkaline; clear wavy boundary.

Bkyz—9 to 16 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and slightly plastic; common roots; few fine accumulations of carbonate; few fine masses of gypsum and other salts; strong effervescence; moderately alkaline; clear wavy boundary.

Cyz—16 to 27 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; massive; hard, friable, sticky and slightly plastic; few roots; few fine accumulations of carbonate; few fine masses of gypsum and other salts; violent effervescence; moderately alkaline; clear wavy boundary.

Cr1—27 to 45 inches; pale olive (5Y 6/4) siltstone, olive (5Y 5/4) moist; massive; hard, friable; common fine accumulations of carbonate; few fine masses of gypsum and other salts; violent effervescence; moderately alkaline; clear wavy boundary.

Cr2—45 to 60 inches; light gray (10YR 7/2) and brownish yellow (10YR 6/6) siltstone, light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) moist; massive; hard, friable; common fine accumulations carbonate; few fine masses of gypsum and other salts; violent effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 6 to 10 inches
Depth to contrasting parent material: 20 to 40 inches over siltstone bedrock
Depth to gypsum and other visible salts: 8 to 16 inches

E horizon:

Hue—10YR; value—5 or 6 (3 or 4 moist); and chroma—1 or 2

Texture—dominantly silt loam but loam in some pedons

Btn horizon:

Hue—10YR; value—4 to 6 (3 or 4 moist); and chroma—2 or 3

Texture—clay or clay loam

Bkyz horizon:

Hue—10YR; value—5 to 7 (4 to 6 moist); and chroma—2 or 3

Texture—silty clay loam or clay loam

C horizon:

Hue—10YR or 7.5YR; value—5 to 7 (4 to 6 moist); and chroma—2 or 3

Texture—silty clay loam or clay loam

Cr horizon:

Hue—5YR to 5Y; value—6 to 8 (5 or 6 moist); and chroma—1 to 6

Kind of bedrock—siltstone

Wendte Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained

Permeability: Slow
Landform: Flood plains
Parent material: Calcareous, clayey alluvium
Slope: 0 to 2 percent

Typical Pedon

Wendte silty clay, 50 feet west and 1,136 feet north of the southeast corner of sec. 17, T. 7 N., R. 20 E.

A—0 to 6 inches; grayish brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak fine granular structure; hard, firm, sticky and plastic; many roots; slight effervescence; slightly alkaline; clear wavy boundary.

C1—6 to 13 inches; grayish brown (2.5Y 5/2), stratified clay, dark grayish brown (2.5Y 4/2) moist; weak fine granular and subangular blocky structure; hard, firm, sticky and plastic; many roots; slight effervescence; slightly alkaline; abrupt smooth boundary.

C2—13 to 42 inches; grayish brown (2.5Y 5/2), stratified clay, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky and plastic; common roots; strong effervescence; slightly alkaline; abrupt wavy boundary.

C3—42 to 60 inches; light brownish gray (10YR 6/2), stratified silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, slightly sticky and slightly plastic; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 6 inches
Depth to contrasting parent material: More than 60 inches
Depth to gypsum and other visible salts: 20 to more than 60 inches

A horizon:
Hue—10YR, 2.5Y, or 5Y; value—4 or 5 (2 or 3 moist); and chroma—1 or 2
Texture—dominantly silty clay but clay, silty clay loam, or clay loam in some pedons

C horizon:
Hue—10YR, 2.5Y, or 5Y; value—4 to 7 (3 to 6 moist); and chroma—1 to 4
Texture—clay, silty clay loam, or silty clay

Wortman Series

Depth to bedrock: Moderately deep
Drainage class: Moderately well drained
Permeability: Very slow
Landform: Plains
Parent material: Silty residuum derived from siltstone bedrock
Slope: 0 to 2 percent

Typical Pedon

Wortman silt loam, in an area of Wortman-Wanblee silt loams, 0 to 2 percent slopes, 2,440 feet east and 2,038 feet north of the southwest corner of sec. 22, T. 3 N., R. 18 E.

E—0 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak thin platy and weak fine granular structure; soft, very friable; many roots; slightly acid; abrupt smooth boundary.

Btn1—5 to 8 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; light brownish gray (10YR 6/2) coatings on the top of columns; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, slightly sticky and plastic; shiny films on faces of peds; many roots; neutral; clear smooth boundary.

Btn2—8 to 13 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, slightly sticky and plastic; shiny films on faces of peds; common roots; moderately alkaline; clear wavy boundary.

Bk—13 to 18 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse subangular blocky structure; slightly hard, friable, sticky and slightly plastic; common roots; common fine accumulations of carbonate; strong effervescence; moderately alkaline; clear wavy boundary.

C—18 to 36 inches; light olive brown (2.5Y 5/3) silty clay loam, olive brown (2.5Y 4/3) moist; massive; slightly hard, friable, sticky and slightly plastic; few roots; violent effervescence; moderately alkaline; clear wavy boundary.

Cr—36 to 60 inches; light reddish brown (5YR 6/4), soft siltstone, reddish brown (5YR 5/4) moist; massive; hard, friable; violent effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 12 inches
Depth to carbonates: 6 to 18 inches
Depth to contrasting parent material: 20 to 40 inches over siltstone bedrock
Depth to gypsum and other visible salts: 10 to more than 60 inches

E horizon:
Hue—10YR; value—5 to 7 (3 or 4 moist); and chroma—1 or 2
Texture—dominantly silt loam but loam in some pedons

Btn horizon:

Hue—10YR; value—4 or 5 (3 or 4 moist); and chroma—2 or 3

Texture—clay, clay loam, silty clay, or silty clay loam

Bk horizon:

Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 to 4

Texture—silty clay loam, clay loam, or loam

C horizon:

Hue—10YR or 2.5Y; value—5 to 7 (4 to 6 moist); and chroma—2 to 4

Texture—silty clay loam, silt loam, or loam

Cr horizon:

Hue—5YR to 2.5Y; value—6 to 8 (5 to 7 moist); and chroma—1 to 6

Kind of bedrock—siltstone

Formation of the Soils

Soil forms when chemical and physical processes act on geologically deposited or accumulated material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material, the climate under which the soil material accumulated and has existed since accumulation, the plant and animal life on and in the soil, the relief, and the length of time that the forces of soil formation have acted on the soil material.

Climate and plant and animal life are active factors of soil formation. They act on the parent material and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are modified by relief. The parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for the transformation of the parent material into a soil having genetically related horizons. Usually, a long time is required for development of distinct horizons. The time required depends on the intensity of climatic factors, the parent material, and the living organisms.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

Climate

Climate directly influences the rate of chemical and physical weathering. Haakon County has a continental climate marked by cold winters and hot summers *(6)*. This climate favors the growth of grasses and the resulting accumulation of organic matter in the upper part of the soil. It also favors a moderately slow rate of weathering or soil formation. The climate in the eastern part of the county is somewhat wetter than that in the western part. Thus, it is a factor in differentiating some of the soils within the county. Detailed information about the climate is given under the heading "General Nature of the County."

Plant and Animal Life

Plants, animals, insects, earthworms, bacteria, actinomycetes, and fungi have an important effect on soil formation. They cause gains in organic matter, gains or losses in plant nutrients, and changes in soil structure and porosity. In Haakon County prairie grasses have had more influence than other living organisms on soil formation. As a result of these grasses, the surface layer of many soils has a moderate content of organic matter. The gently sloping Ottumwa soils contain more organic matter than the more sloping Samsil soils because they have a more extensive grass cover.

Earthworms, insects, and burrowing animals help to keep the soil open and porous. Bacteria and fungi decompose plant residue, thus releasing plant nutrients.

Parent Material

Parent material is the unconsolidated organic and mineral material in which a soil forms. It determines many of the chemical and physical characteristics of the soil, such as color, texture, reaction, consistence, and natural fertility. The rate of soil formation is more rapid in the more friable, loamy parent material than in other kinds of parent material. Also, more changes take place, and the horizons are more distinct.

Most of the soils in Haakon County formed in material weathered from the underlying bedrock. The rest formed in old alluvial deposits on high terraces or in recent alluvial deposits on flood plains, on foot slopes, and in basins on uplands.

There are two major geological formations in Haakon County. These are the Fox Hills Formation in the western part of the county and the Pierre Formation in the eastern part.

The Pierre Formation consists of clayey shale. It underlies the entire county but is exposed only in the eastern part. It is gray to light olive gray and has beds of bentonite and seams of limestone, iron, and manganese concretions. Bullcreek, Lakoma, Okaton, Opal, Pierre, Promise, Sansarc, and Samsil are examples of soils that formed in material weathered from the Pierre Formation.

The Fox Hills Formation overlies the Pierre Formation. It consists of interbedded shale and sandstone. It is conspicuous because of the majestic sandstone-capped buttes and the brownish hue of the soils in the area. Blackpipe, Midway, Razor, Savo, and Shingle are examples of soils that formed in material weathered from the Fox Hills Formation.

Alluvium is recently deposited sandy to clayey material on flood plains and older deposits of loamy material on high terraces, mainly along the Cheyenne River and the Bad River. Kirley and Ree are examples of soils that formed in old alluvium on high terraces. Bankard, Craft, Haverson, Nimbro, and Wendte soils formed in recent alluvium on the flood plains along the Cheyenne River and the Bad River. Hoven and Kolls are examples of soils that formed in alluvium in basins on uplands. Onita soils, which are on foot slopes, formed in local alluvium washed from the adjacent uplands.

Relief

Relief affects soil formation through its effect on drainage, runoff, erosion, plant cover, and soil temperature. On the more sloping soils, such as Okaton soils, much of the rainfall is lost through runoff. As a result of the excessive runoff, a limited amount of moisture penetrates the surface and much of the soil material is lost through erosion. These soils have a thin surface layer and a low content of organic matter. Runoff is slower on Kirley, Ottumwa, Ree, and other less sloping soils, and more moisture penetrates the surface. These soils are calcareous at a greater depth than the Okaton soils. Also, the horizons in which organic matter accumulates are thicker.

Hoven and Kolls soils are in basins where water ponds. They have the colors characteristic of poorly drained soils. Onita and other soils on foot slopes receive extra moisture in the form of runoff from the adjacent soils. The layers in which organic matter accumulates are thicker than those in the slightly higher adjacent Ree and Kirley soils. In low areas, where drainage is impeded, a fluctuating water table favors the concentration of salts in Egas, Herdcamp, and other soils.

Time

The length of time that soil material has been exposed to the other four factors of soil formation is reflected in the kinds of soil that form. Generally, the degree of profile development reflects the age of a soil. The oldest soils are on the parts of the landscape that have been stable for the longest time. These are the Kirley and Promise soils, which have distinct horizons. The youngest soils either are those in which natural erosion removes nearly as much soil material as is formed through the weathering of parent material or are alluvial soils, which receive new material each time they are flooded. Okaton and Sansarc are examples of young soils that are subject to natural erosion. Bankard and Craft are examples of young alluvial soils.

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Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hill slopes. Back slopes are commonly steep and linear and descend to a foot slope. They are erosional slopes formed mainly through mass wasting and running water.

Basin. A depressional area with no surface outlet. Examples are closed depressions on residual upland plains.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by the wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet. It commonly is associated with natric horizons.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition

of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:
Loose.—Noncoherent when dry or moist; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth, soil. The thickness of weathered soil material over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep soils, 20 to 40 inches; and shallow soils, less than 20 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit the growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage

results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess salt (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sodium (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Fine textured soil. Sandy clay, silty clay, or clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Gilgai. Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is more than 15 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E

horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and are less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Interfluve. The relatively undissected upland or ridge between two adjacent valleys having streams that flow in the same general direction. Any elevated area between two drainageways that sheds water to them.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from both a high and low pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Landform. Any recognizable form or feature of the earth's surface having a characteristic shape and produced by natural causes.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Mollic epipedon. A thick, dark, humus-rich surface

horizon (or horizons) having high base saturation and pedogenic soil structure. It may include part of the subsoil.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon. A special kind of argillic horizon that contains enough exchangeable sodium for the physical condition of the subsoil to be adversely affected.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential for its growth and life cycle. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Pasture, tame. Grazing land planted primarily to introduced or domestic native forage species. The pasture is periodically improved by renovation; by cultural treatment, such as tillage, applications of fertilizer, mowing, weed control, and irrigation; or by a combination of these.

Ped. An individual natural soil aggregate or structural unit, such as a granule, a prism, or a block developed by soil genesis.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many

wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	0.0 to 3.4
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7 8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 to 14.0

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rock outcrop. Eroding exposures of soft bedrock, such as sandstone, siltstone, and shale.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs the growth of plants. The electrical conductivity is more than 4 millimhos per centimeter. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shoulder slope. The uppermost inclined surface at the top of a hill slope. A transition zone from the back slope to the summit of an upland. It is dominantly convex in profile and erosional in origin.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slickspot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100.

Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. The slope classes recognized in this survey area are as follows:

Nearly level	0 to 2 or 3 percent
Gently undulating	1 to 3 percent
Gently sloping or undulating	2 or 3 to 6 percent
Moderately sloping or gently rolling	6 to 9 percent
Strongly sloping	9 to 15 percent
Moderately steep	15 to 25 percent
Steep	25 to 40 percent
Very steep	40 percent or more

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Summit. The top or highest level of an upland feature. A high interfluve area of gentler slope that is flanked by steeper hill slopes.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). A layer of otherwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration. Tilth is affected by soil structure, permeability, porosity, bulk density, and other soil features.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Transitional layer. A layer of soil that grades to the next layer or includes parts of adjacent layers, commonly between the surface layer and the subsoil or underlying layer.

Underlying layer. The C, Cr, or R horizon; that part of the soil below the subsoil, commonly the parent material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-87 at Phillip, South Dakota)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average daily	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	30.0	5.5	17.8	62	16	27	0.25	0.07	0.37	1	3.3
February----	36.9	11.8	24.4	71	16	42	.37	.08	.59	2	6.0
March-------	44.1	19.7	31.9	79	16	88	.86	.21	1.35	3	6.5
April-------	59.5	32.4	46.0	90	11	219	1.73	.57	2.63	4	3.4
May---------	70.8	43.4	57.1	95	25	530	2.97	1.37	4.19	6	.3
June--------	80.8	53.5	67.2	104	36	816	3.24	1.59	4.65	7	.0
July--------	90.4	59.3	74.9	109	44	1,082	2.02	.71	3.00	5	.0
August------	89.5	57.5	73.5	108	41	1,039	1.62	.53	2.40	4	.0
September---	77.4	45.8	61.6	104	25	648	1.07	.21	1.69	3	.0
October-----	64.4	34.2	49.3	93	14	306	.92	.12	1.52	2	.5
November----	47.3	20.8	34.1	77	14	53	.37	.06	.57	1	2.8
December----	35.1	10.4	22.8	68	14	36	.31	.06	.49	1	4.3
Yearly:											
Average---	60.5	32.9	46.7	---	---	---	---	---	---	---	---
Extreme---	---	---	---	109	14	---	---	---	---	---	---
Total-----	---	---	---	---	---	4,886	15.73	12.85	17.56	39	27.1

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-87 at Phillip, South Dakota)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 7	May 18	May 22
2 years in 10 later than--	Apr. 30	May 11	May 18
5 years in 10 later than--	Apr. 18	Apr. 27	May 11
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 28	Sept. 22	Sept. 10
2 years in 10 earlier than--	Oct. 3	Sept. 26	Sept. 15
5 years in 10 earlier than--	Oct. 13	Oct. 4	Sept. 24

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-87 at Phillip, South Dakota)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	154	133	119
8 years in 10	162	142	124
5 years in 10	177	159	136
2 years in 10	193	177	147
1 year in 10	201	186	153

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ab	Albaton silty clay, depressional	539	*
Ar	Arvada silt loam	1,401	0.1
As	Arvada-Slickspots complex	317	*
Bc	Bankard loamy sand, hummocky	1,832	0.2
Bd	Bankard very fine sandy loam	1,841	0.2
BkA	Blackpipe silty clay loam, 0 to 2 percent slopes	1,114	0.1
BkB	Blackpipe silty clay loam, 2 to 6 percent slopes	3,390	0.3
Bo	Blackpipe-Wortman complex	2,802	0.2
Bu	Bullcreek clay, 0 to 6 percent slopes	11,942	1.0
Bx	Bullcreek-Slickspots complex	1,816	0.2
Ca	Canning loam	2,099	0.2
CbA	Capa silt loam, 0 to 6 percent slopes	5,111	0.4
Cc	Capa-Slickspots complex	1,096	0.1
Ct	Capa-Wendte, channeled, complex	17,882	1.5
Cv	Craft very fine sandy loam	1,404	0.1
Eg	Egas silty clay loam	989	0.1
Ha	Haverson silt loam	1,323	0.1
Hb	Haverson silt loam, channeled	1,020	0.1
Hc	Haverson-Craft complex	1,878	0.2
Ho	Hilmoe silty clay	709	0.1
HpB	Hisle silt loam, 0 to 6 percent slopes	90	*
Hv	Hoven silt loam	1,807	0.2
KeA	Kirley clay loam, 0 to 2 percent slopes	15,554	1.3
KeB	Kirley clay loam, 2 to 6 percent slopes	19,258	1.6
KeD	Kirley clay loam, 6 to 15 percent slopes	3,030	0.3
KfB	Kirley-Canning complex, 2 to 6 percent slopes	4,412	0.4
KhA	Kirley-Mosher complex, 0 to 2 percent slopes	6,230	0.5
KhB	Kirley-Mosher complex, 2 to 6 percent slopes	5,737	0.5
KmA	Kirley-Ottumwa complex, 0 to 2 percent slopes	411	*
KmB	Kirley-Ottumwa complex, 2 to 6 percent slopes	19,170	1.6
KmC	Kirley-Ottumwa complex, 6 to 9 percent slopes	4,448	0.4
KnD	Kirley-Vivian complex, 6 to 15 percent slopes	12,962	1.1
Ko	Kolls clay	4,074	0.3
KyA	Kyle clay, 0 to 3 percent slopes	1,667	0.1
KyB	Kyle clay, 3 to 6 percent slopes	4,101	0.4
LaB	Lakoma silty clay, 3 to 6 percent slopes	14,472	1.2
LaC	Lakoma silty clay, 6 to 9 percent slopes	33,863	2.9
LaD	Lakoma silty clay, 6 to 15 percent slopes	97,889	8.4
LbE	Lakoma-Vivian complex, 9 to 25 percent slopes	27,282	2.3
Lo	Lohmiller silty clay	1,103	0.1
Lp	Lohmiller silty clay, channeled	9,358	0.8
Lv	Lohmiller-Arvada complex	4,919	0.4
MaE	Midway silty clay loam, 15 to 40 percent slopes	11,027	0.9
Mo	Mosher silt loam	1,724	0.1
Nb	Nimbro silty clay loam	11,518	1.0
Nc	Nimbro silty clay loam, channeled	8,041	0.7
NuA	Nunn loam, 0 to 2 percent slopes	645	0.1
NuB	Nunn loam, 2 to 6 percent slopes	1,524	0.1
NuC	Nunn loam, 6 to 9 percent slopes	179	*
NxD	Nunn-Nihill complex, 6 to 15 percent slopes	251	*
ObE	Okaton-Lakoma silty clays, 15 to 40 percent slopes	64,017	5.5
Oc	Onita silt loam	2,120	0.2
OdB	Opal clay, 3 to 6 percent slopes	9,261	0.8
OdC	Opal clay, 6 to 9 percent slopes	9,189	0.8
OdD	Opal clay, 6 to 15 percent slopes	19,141	1.6
OeB	Opal-Promise clays, 3 to 6 percent slopes	14,056	1.2
OeC	Opal-Promise clays, 6 to 9 percent slopes	10,923	0.9
Of	Orthents, clayey	284	*
Og	Orthents, gravelly	205	*
OtA	Ottumwa silty clay, 0 to 3 percent slopes	29,321	2.5
OtB	Ottumwa silty clay, 3 to 6 percent slopes	114,516	9.8
OvA	Ottumwa-Capa complex, 0 to 3 percent slopes	24,014	2.1

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
OwB	Ottumwa-Lakoma silty clays, 3 to 6 percent slopes	49,377	4.2
OwC	Ottumwa-Lakoma silty clays, 6 to 9 percent slopes	45,459	3.9
OxC	Ottumwa-Razor silty clays, 6 to 9 percent slopes	19,161	1.6
OyC	Ottumwa-Razor-Savo complex, 6 to 15 percent slopes	12,404	1.1
PeC	Pierre clay, 6 to 9 percent slopes	11,565	1.0
PeD	Pierre clay, 6 to 15 percent slopes	29,806	2.6
PkE	Pierre-Samsil clays, 15 to 25 percent slopes	37,122	3.2
PrA	Promise clay, 0 to 3 percent slopes	13,657	1.2
PrB	Promise clay, 3 to 6 percent slopes	11,634	1.0
RaB	Razor silty clay, 2 to 6 percent slopes	20	*
RaC	Razor silty clay, 6 to 9 percent slopes	51	*
RbD	Razor-Midway complex, 6 to 15 percent slopes	32,147	2.8
RdD	Razor-Shingle complex, 6 to 15 percent slopes	1,007	0.1
ReA	Ree loam, 0 to 2 percent slopes	42,628	3.6
ReB	Ree loam, 2 to 6 percent slopes	5,775	0.5
RfB	Ree-Canning loams, 2 to 6 percent slopes	4,697	0.4
RfC	Ree-Canning loams, 6 to 9 percent slopes	1,843	0.2
Rh	Ree-Hoven complex	859	0.1
RkD	Ree-Vivian complex, 6 to 15 percent slopes	3,790	0.3
Rv	Riverwash	898	0.1
SbF	Samsil clay, 25 to 60 percent slopes	63,143	5.4
ScF	Samsil-Nihill complex, 6 to 40 percent slopes	2,451	0.2
SdF	Samsil-Rock outcrop complex, 15 to 60 percent slopes	19,471	1.7
SoE	Sansarc-Opal clays, 9 to 40 percent slopes	11,155	1.0
SrA	Savo silt loam, 0 to 2 percent slopes	2,011	0.2
SrB	Savo silt loam, 2 to 6 percent slopes	13,672	1.2
SrC	Savo silt loam, 6 to 9 percent slopes	26	*
StF	Schamber-Samsil complex, 6 to 60 percent slopes	28,742	2.5
SuE	Shingle silty clay loam, 15 to 40 percent slopes	65	*
SwE	Shingle-Razor complex, 15 to 25 percent slopes	414	*
Wc	Wendte silty clay	6,925	0.6
Wd	Wendte-Herdcamp silty clays, channeled	8,706	0.7
WsE	Wendte, channeled-Sansarc complex, 0 to 60 percent slopes	475	*
Ww	Wortman-Wanblee silt loams, 0 to 2 percent slopes	729	0.1
	Water	2,041	0.1
	Total	1,168,224	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
Ca	Canning loam (where irrigated)
Cv	Craft very fine sandy loam (where irrigated)
Ha	Haverson silt loam (where irrigated)
Hc	Haverson-Craft complex (where irrigated)
Ho	Hilmoe silty clay (where irrigated)
KeA	Kirley clay loam, 0 to 2 percent slopes (where irrigated)
KeB	Kirley clay loam, 2 to 6 percent slopes (where irrigated)
KfB	Kirley-Canning complex, 2 to 6 percent slopes (where irrigated)
Nb	Nimbro silty clay loam (where irrigated)
NuA	Nunn loam, 0 to 2 percent slopes (where irrigated)
NuB	Nunn loam, 2 to 6 percent slopes (where irrigated)
Oc	Onita silt loam
ReA	Ree loam, 0 to 2 percent slopes (where irrigated)
ReB	Ree loam, 2 to 6 percent slopes (where irrigated)
RfB	Ree-Canning loams, 2 to 6 percent slopes (where irrigated)
SrA	Savo silt loam, 0 to 2 percent slopes (where irrigated)
SrB	Savo silt loam, 2 to 6 percent slopes (where irrigated)

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Alfalfa-hay	Grain sorghum	Oats	Cool-season grass	Spring wheat	Winter wheat
	Tons	Bu	Bu	AUM*	Bu	Bu
Ab. Albaton						
Ar. Arvada						
As**. Arvada-Slickspots						
Bc. Bankard	---	---	---	---	---	20
Bd. Bankard						
BkA. Blackpipe	1.6	42	45	3.0	---	34
BkB. Blackpipe	1.5	40	41	3.0	---	32
Bo**. Blackpipe-Wortman	1.6	32	36	2.2	---	26
Bu. Bullcreek						
Bx**. Bullcreek-Slickspots						
Ca. Canning	1.3	35	40	2.9	25	32
CbA. Capa						
Cc**. Capa-Slickspots						
Ct**. Capa-Wendte						
Cv. Craft	1.9	40	45	3.0	24	32
Eg. Egas						
Ha. Haverson	1.5	19	45	3.0	---	---
Hb. Haverson						
Hc**. Haverson-Craft						

See footnotes at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Alfalfa-hay	Grain sorghum	Oats	Cool-season grass	Spring wheat	Winter wheat
	Tons	Bu	Bu	AUM*	Bu	Bu
Ho------------------------ Hilmoe	1.8	32	40	2.4	20	32
HpB. Hisle						
Hv. Hoven						
KeA----------------------- Kirley	1.8	41	44	3.0	26	34
KeB----------------------- Kirley	1.7	39	41	2.8	25	33
KeD----------------------- Kirley	1.2	---	---	2.0	---	---
KfB**--------------------- Kirley-Canning	1.5	37	38	2.6	23	31
KhA**--------------------- Kirley-Mosher	1.6	34	35	2.4	19	30
KhB**--------------------- Kirley-Mosher	1.6	34	33	2.3	18	29
KmA**--------------------- Kirley-Ottumwa	1.7	42	45	3.0	26	36
KmB**--------------------- Kirley-Ottumwa	1.7	40	41	2.8	25	34
KmC**--------------------- Kirley-Ottumwa	1.5	35	37	2.5	22	32
KnD**. Kirley-Vivian						
Ko. Kolls						
KyA----------------------- Kyle	1.4	37	33	2.2	23	30
KyB----------------------- Kyle	1.4	35	31	2.0	21	29
LaB----------------------- Lakoma	1.1	31	32	2.2	18	25
LaC----------------------- Lakoma	0.9	24	27	2.0	15	21
LaD. Lakoma						
LbE**. Lakoma-Vivian						

See footnotes at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Alfalfa-hay	Grain sorghum	Oats	Cool-season grass	Spring wheat	Winter wheat
	Tons	Bu	Bu	AUM*	Bu	Bu
Lo------------------------ Lohmiller	1.6	---	30	2.7	20	29
Lp------------------------ Lohmiller	2.0	---	---	---	---	---
Lv**. Lohmiller-Arvada						
MaE. Midway						
Mo------------------------ Mosher	1.1	20	27	1.8	13	18
Nb------------------------ Nimbro	2.0	40	48	3.3	26	32
Nc. Nimbro						
NuA----------------------- Nunn	1.6	40	42	2.8	24	32
NuB----------------------- Nunn	1.5	38	39	2.6	23	30
NuC----------------------- Nunn	1.6	33	37	2.7	21	30
NxD**. Nunn-Nihill						
ObE**. Okaton-Lakoma						
Oc------------------------ Onita	2.5	58	60	3.6	26	40
OdB----------------------- Opal	1.4	35	41	2.3	21	31
OdC----------------------- Opal	1.3	26	33	2.1	17	26
OdD. Opal						
OeB**--------------------- Opal-Promise	1.4	39	42	2.[illegible]	21	32
OeC**--------------------- Opal-Promise	1.3	30	33	2.1	18	27
Of**. Orthents, clayey						
Og**. Orthents, gravelly						

See footnotes at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Alfalfa-hay	Grain sorghum	Oats	Cool-season grass	Spring wheat	Winter wheat
	Tons	Bu	Bu	AUM*	Bu	Bu
OtA----------------------- Ottumwa	1.5	44	45	2.5	25	38
OtB----------------------- Ottumwa	1.5	42	42	2.4	23	36
OvA**. Ottumwa-Capa						
OwB**--------------------- Ottumwa-Lakoma	1.4	37	39	2.3	21	32
OwC**--------------------- Ottumwa-Lakoma	1.3	32	34	2.0	18	28
OxC**--------------------- Ottumwa-Razor	1.1	---	32	---	---	29
OyC**. Ottumwa-Razor-Savo						
PeC----------------------- Pierre	1.1	20	24	1.8	16	20
PeD. Pierre						
PkE**. Pierre-Samsil						
PrA----------------------- Promise	1.5	44	45	2.4	24	36
PrB----------------------- Promise	1.5	42	42	2.4	23	34
RaB----------------------- Razor	0.9	30	35	1.8	---	30
RaC----------------------- Razor	0.7	---	25	1.6	---	25
RbD**. Razor-Midway						
RdD**. Razor-Shingle						
ReA----------------------- Ree	1.8	42	47	3.0	26	35
ReB----------------------- Ree	1.7	39	45	2.8	25	33
RfB**--------------------- Ree-Canning	1.3	38	38	2.6	21	31
RfC**--------------------- Ree-Canning	1.1	31	35	2.2	18	28

See footnotes at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Alfalfa-hay	Grain sorghum	Oats	Cool-season grass	Spring wheat	Winter wheat
	Tons	Bu	Bu	AUM*	Bu	Bu
Rh**. Ree-Hoven	1.7	41	46	2.9	25	32
RkD**. Ree-Vivian						
Rv**. Riverwash						
SbF. Samsil						
ScF**. Samsil-Nihill						
SdF**. Samsil-Rock outcrop						
SoE**. Sansarc-Opal						
SrA. Savo	1.7	43	46	3.0	---	35
SrB. Savo	1.6	40	45	2.8	---	33
SrC. Savo	1.4	33	38	2.4	---	30
StF**. Schamber-Samsil						
SuE. Shingle						
SwE**. Shingle-Razor						
Wc. Wendte	1.8	38	50	2.5	---	32
Wd**. Wendte-Herdcamp						
WsE**. Wendte-Sansarc						
Ww**. Wortman-Wanblee						

* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--RANGELAND CHARACTERISTIC VEGETATION AND PRODUCTIVITY

Range site, soil name, and map symbols	Potential natural plant community: Common plant name	Composition	Potential annual production for kind of growing season: Favorable	Average	Unfavorable
		Pct	Lb/acre	Lb/acre	Lb/acre
Clayey	Western wheatgrass	45	2,500	2,100	1,500
Kirley: KeA, KeB, KeD, KfB, KhA, KhB, KmA, KmB, KmC, KnD	Green needlegrass	25			
Kyle: KyA, KyB	Blue grama	10			
Opal: OdB, OdC, OdD, OeB, OeC, SoE	Sideoats grama	5			
Ottumwa: KmA, KmB, KmC, OtA, OtB, OvA, OwB, OwC, OxC, OyC	Buffalograss	5			
Pierre: PeC, PeD, PkE	Sedges	5			
Promise: OeB, OeC, PrA, PrB	Climax forbs	5			
Razor: OxC, OyC, RaB, RaC, RbD, RdD, SwE					
Clayey Overflow	Western wheatgrass	55	3,600	3,000	2,100
Albaton: Ab	Green needlegrass	20			
Hilmoe: Ho	Blue grama	5			
Wendte: Ct, Wc, Wd, WsE	Buffalograss	5			
	Trees	5			
	Climax forbs	5			
	Climax shrubs	5			
Claypan	Western wheatgrass	40	1,900	1,600	1,100
Mosher: KhA, KhB, Mo	Green needlegrass	20			
Wortman: Bo, Ww	Blue grama	15			
	Sedges	5			
	Buffalograss	5			
	Needleandthread	5			
	Climax forbs	5			
	Climax shrubs	5			
Closed Depression	Western wheatgrass	85	3,000	2,800	1,900
Hoven: Hv, Rh	Sedges	10			
Kolls: Ko	Climax forbs	5			
Dense Clay	Western wheatgrass	70	2,000	1,500	900
Bullcreek: Bu, Bx	Green needlegrass	20			
	Climax forbs	5			
	Climax shrubs	5			
Loamy Overflow	Big bluestem	40	5,300	4,400	3,100
Haverson: Hb	Western wheatgrass	15			
Lohmiller: Lp	Switchgrass	10			
Nimbro: Nc	Indiangrass	5			
Onita: Oc	Green needlegrass	5			
	Bluegrasses	5			
	Little bluestem	5			
	Trees	5			
	Climax forbs	5			
	Climax shrubs	5			
Loamy Terrace	Western wheatgrass	30	3,300	2,700	1,900
Craft: Cv, Hc	Green needlegrass	30			
Haverson: Ha, Hc	Needleandthread	10			
Lohmiller: Lo, Lv	Little bluestem	5			
Nimbro: Nb	Big bluestem	5			
	Prairie sandreed	5			
	Blue grama	5			
	Climax forbs	5			
	Climax shrubs	5			

TABLE 7.--RANGELAND CHARACTERISTIC VEGETATION AND PRODUCTIVITY--Continued

Range site, soil name, and map symbols	Potential natural plant community: Common plant name	Composition	Potential annual production for kind of growing season: Favorable	Average	Unfavorable
		Pct	Lb/acre	Lb/acre	Lb/acre
Saline Lowland-----------	Western wheatgrass-----------	35	3,100	2,800	2,200
Egas: Eg	Nuttall alkaligrass----------	25			
	Inland saltgrass-------------	15			
	Alkali sacaton---------------	10			
	Prairie cordgrass------------	5			
	Foxtail barley---------------	5			
	Climax forbs-----------------	5			
Sands--------------------	Prairie sandreed-------------	25	2,900	2,400	1,700
Bankard: Bc	Little bluestem--------------	20			
	Big bluestem-----------------	15			
	Sand bluestem----------------	10			
	Switchgrass------------------	5			
	Indiangrass------------------	5			
	Needleandthread--------------	5			
	Blue grama-------------------	5			
	Climax forbs-----------------	5			
	Climax shrubs----------------	5			
Sandy--------------------	Prairie sandreed-------------	20	2,800	2,300	1,600
Bankard: Bd	Little bluestem--------------	20			
	Big bluestem or sand bluestem	20			
	Needleandthread--------------	15			
	Western wheatgrass-----------	5			
	Sideoats grama---------------	5			
	Blue grama-------------------	5			
	Sedges-----------------------	5			
	Climax forbs-----------------	5			
Shallow------------------	Little bluestem--------------	40	2,000	1,700	1,200
Okaton: ObE	Sideoats grama---------------	10			
Shingle: RdD, SuE, SwE	Blue grama-------------------	10			
	Plains muhly-----------------	5			
	Big bluestem-----------------	5			
	Green needlegrass------------	5			
	Western wheatgrass-----------	5			
	Needleandthread--------------	5			
	Sedges-----------------------	5			
	Climax forbs-----------------	5			
	Climax shrubs----------------	5			
Shallow Clay-------------	Little bluestem--------------	30	2,000	1,700	1,200
Midway: MaE, RbD	Western wheatgrass-----------	20			
Samsil: PkE, SbF, ScF, SdF, StF	Green needlegrass------------	20			
	Sideoats grama---------------	5			
Sansarc: SoE, WsE	Big bluestem-----------------	5			
	Blue grama-------------------	5			
	Sedges-----------------------	5			
	Climax forbs-----------------	5			
	Climax shrubs----------------	5			
Silty--------------------	Western wheatgrass-----------	35	2,700	2,300	1,600
Blackpipe; BkA, BkB, Bo	Green needlegrass------------	15			
Canning: Ca, KfB, RfB, RfC	Needleandthread--------------	10			
	Blue grama-------------------	10			
Nunn: NuA, NuB, NuC, NxD	Climax forbs-----------------	10			
Ree: ReA, ReB, RfB, RfC, Rh, RkD	Sideoats grama---------------	5			
	Porcupinegrass---------------	5			
Savo: OyC, SrA, SrB, SrC	Big bluestem-----------------	5			
	Climax shrubs----------------	5			

TABLE 7.--RANGELAND CHARACTERISTIC VEGETATION AND PRODUCTIVITY--Continued

Range site, soil name, and map symbols	Potential natural plant community: Common plant name	Composition	Potential annual production for kind of growing season: Favorable	Average	Unfavorable
		Pct	Lb/acre	Lb/acre	Lb/acre
Thin Claypan	Western wheatgrass	25	1,300	1,100	700
Arvada: Ar, As, Lv	Blue grama	25			
Capa: CbA, Cc, Ct, OvA	Needleandthread	15			
Hisle: HpB	Buffalograss	15			
Wanblee: Ww	Climax forbs	10			
	Sedges	5			
	Inland saltgrass	5			
Thin Upland	Little bluestem	20	2,100	1,800	1,200
Lakoma: LaB, LaC, LaD, LbE, ObE, OwB, OwC	Big bluestem	20			
Vivian: KnD, LbE, RkD	Sideoats grama	10			
	Blue grama	5			
	Prairie sandreed	5			
	Porcupinegrass	5			
	Green needlegrass	5			
	Needleandthread	5			
	Western wheatgrass	5			
	Needleleaf sedge	5			
	Threadleaf sedge	5			
	Climax forbs	5			
	Climax shrubs	5			
Very Shallow	Blue grama	25	1,200	1,000	600
Nihill: NxD, ScF	Needleandthread	20			
Schamber: StF	Threadleaf sedge	15			
	Little bluestem	10			
	Sideoats grama	10			
	Western wheatgrass	10			
	Climax forbs	5			
	Climax shrubs	5			
Wetland	Prairie cordgrass	70	6,300	5,800	4,700
Hardcamp: Wd	Switchgrass	5			
	Canada wildrye	5			
	Sedges	5			
	Rushes	5			
	Climax forbs	5			
	Climax shrubs	5			

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(None of the soils in Haakon County are assigned to windbreak suitability group 2. The symbol < means less than; > means more than. Dashes indicate that trees generally do not grow to the given height on the soils in that group)

Windbreak suitability group, soil name, and map symbols	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Group 1----------- Craft: Cv, Hc Haverson: Ha, Hb, Hc Lohmiller: Lo, Lp, Lv Nimbro: Nb, Nc Onita: Oc	American plum, Amur honeysuckle, common lilac, European cononeaster, golden currant, Hansen hedgerose, juneberry, late lilac, Mongolian cherry, Nanking cherry, Peking cotoneaster, redosier dogwood, Russian almond, silver buffaloberry, skunkbush sumac, western sandcherry.	Amur maple, Arnold hawthorne, common chokecherry, Manchurian apricot, Manchurian crabapple, Siberian apricot, Siberian crabapple, Siberian peashrub, Ussurian pear.	Black Hills spruce, blue spruce, boxelder, bur oak, eastern redcedar, European birdcherry, green ash, hackberry, ponderosa pine, Rocky Mountain juniper, Russian-olive, Scotch pine, white poplar.	Golden willow, Siberian elm, white willow.	Carolina poplar, eastern cottonwood, northwest poplar, plains cottonwood, robusta poplar.
Group 3----------- Kirley: KeA, KeB, KeD, KfB, KhA, KhB, KmA, KmB, KmC, KnD Nunn: NuA, NuB, NuC, NxD Ree: ReA, ReB, RfB, RfC, Rh, RkD Savo: OyC, SrA, SrB, SrC	American plum, Amur honeysuckle, common lilac, European cotoneaster, golden currant, Hansen hedgerose, juneberry, late lilac, Mongolian cherry, Nanking cherry, Peking cotoneaster, redosier dogwood, silver buffaloberry, skunkbush sumac, western sandcherry.	Amur maple, Arnold hawthorn, common chokecherry, Eastern redcedar, Manchurian apricot, Manchurian crabapple, Rocky Mountain juniper, Siberian apricot, Siberian crabapple, Siberian peashrub, Ussurian pear.	Black Hills spruce, blue spruce, boxelder, bur oak, European birdcherry, green ash, hackberry, ponderosa pine, Russian-olive, Scotch pine, white poplar.	Siberian elm------	---
Group 4----------- Hilmoe: Ho Kyle: KyA, KyB Opal: OdB, OdC, OdD, OeB, OeC Ottumwa: KmA, KmB, KmC, OtA, OtB, OvA, OwB, OwC, OxC, OyC Pierre: PeC, PeD Promise: PrA, PrB, OeB, OeC Razor: OxC, OyC, RaB, RaC, RbD, RdD Wendte: Ct, Wc, Wd	American plum, common lilac, European cotoneaster, golden currant, Nanking cherry, Peking cotoneaster, Russian almond, Siberian peashrub, silver buffaloberry, skunkbush sumac.	Arnold hawthorne, common chokecherry, eastern redcedar, green ash, hackberry, Manchurian apricot, Manchurian crabapple, ponderosa pine, Rocky Mountain juniper, Russian-olive, Siberian apricot, Siberian crabapple, Ussurian pear, white poplar.	Siberian elm------	---	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Windbreak suitability group, soil name, and map symbols	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Group 5 Bankard: Bd	American plum, common lilac, golden currant, Peking cotoneaster, silver buffaloberry, skunkbush sumac, western sandcherry.	Bur oak, common chokecherry, eastern redcedar, Manchurian apricot, Manchurian crabapple, Rocky Mountain juniper, Russian-olive, Siberian apricot, Siberian crabapple, Siberian peashrub, Ussurian pear.	Green ash, hackberry, ponderosa pine, white poplar.	Siberian elm	---
Group 6 Blackpipe: BkA, BkB, Bo Canning: Ca, KfB, RfB, RfC	Common lilac, Peking cotoneaster, Siberian peashrub, silver buffaloberry.	Eastern redcedar, green ash, hackberry, Rocky Mountain juniper, Russian-olive.	Ponderosa pine, Siberian elm.	---	---
Group 7 Bankard: Bc	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine	---	---
Group 8 Lakoma: LaB, LaC, OwB, OwC	Common lilac, Russian almond, Siberian peashrub, silver buffaloberry.	Eastern redcedar, green ash, ponderosa pine, Rocky Mountain juniper, Russian-olive, Ussurian pear, white poplar.	Siberian elm	---	---
Group 9 Mosher: KhA, KhB, Mo Wortman: Bo, Ww	Common lilac, eastern redcedar, Rocky Mountain juniper, Russian almond, Siberian peashrub, silver buffaloberry, Ussurian pear.	Green ash, ponderosa pine, Russian-olive, Siberian elm.	---	---	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Windbreak suitability group, soil name, and map symbols	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Group 10----------	None--------------	None--------------	None--------------	None--------------	None.
Albaton: Ab					
Arvada: Ar, As, Lv					
Bullcreek: Bu, Bx					
Capa: CbA, Cc, Ct, OvA					
Egas: Eg					
Herdcamp: Wd					
Hisle: HpB					
Hoven: Hv, Rh					
Kolls: Ko					
Lakoma: LaD, LbE, ObE					
Midway: MaE, RbD					
Nihill: NxD, ScF					
Okaton: ObE					
Opal: SoE					
Orthents: Of, Og					
Pierre: PkE					
Razor: SwE					
Riverwash: Rv					
Rock outcrop: SdF					
Samsil: PkE, SbF, ScF, SdF, StF					
Sansarc: SoE, WsE					
Schamber: StF					
Shingle: RdD, SuE, SwE					
Slickspots: As, Bx, Cc					
Vivian: KnD, LbE, RkD					

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe")

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ab: Albaton	Severe: flooding, ponding, percs slowly.	Severe: ponding, too clayey, percs slowly.	Severe: too clayey, ponding, flooding.	Severe: ponding, too clayey.
Ar: Arvada	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Moderate: dusty.
As*: Arvada	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Moderate: dusty.
Slickspots	Severe: percs slowly, excess salt.	Severe: excess salt, percs slowly.	Severe: percs slowly, excess salt.	Severe: too clayey.
Bc: Bankard	Severe: flooding.	Slight	Moderate: slope.	Slight.
Bd: Bankard	Severe: flooding.	Moderate: dusty.	Moderate: flooding.	Moderate: dusty.
BkA: Blackpipe	Slight	Slight	Slight	Slight.
BkB: Blackpipe	Slight	Slight	Moderate: slope, thin layer, area reclaim.	Slight.
Bo*: Blackpipe	Slight	Slight	Slight	Slight.
Wortman	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Moderate: dusty.
Bu: Bullcreek	Moderate: percs slowly.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Severe: erodes easily.
Bx*: Bullcreek	Moderate: percs slowly.	Moderate: too clayey, percs slowly.	Moderate: too clayey, percs slowly.	Severe: erodes easily.
Slickspots	Severe: percs slowly, excess salt.	Severe: excess salt, percs slowly.	Severe: percs slowly, excess salt.	Severe: too clayey.
Ca: Canning	Slight	Slight	Slight	Slight.
CbA: Capa	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Cc*:				
Capa	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Slickspots	Severe: percs slowly, excess salt.	Severe: excess salt, percs slowly.	Severe: percs slowly, excess salt.	Severe: too clayey.
Ct*:				
Capa	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Wendte	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey, flooding.	Moderate: too clayey.
Cv Craft	Severe: flooding.	Moderate: dusty.	Slight	Moderate: dusty.
Eg Egas	Severe: flooding, wetness.	Severe: wetness, excess salt.	Severe: wetness.	Severe: wetness.
Ha Haverson	Severe: flooding.	Moderate: dusty.	Slight	Moderate: dusty.
Hb Haverson	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Hc*:				
Haverson	Severe: flooding.	Moderate: dusty.	Slight	Moderate: dusty.
Craft	Severe: flooding.	Moderate: dusty.	Slight	Moderate: dusty.
Ho Hilmoe	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
HpB Hisle	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Moderate: dusty.
Hv Hoven	Severe: ponding, percs slowly, excess sodium.	Severe: ponding, excess sodium, percs slowly.	Severe: ponding, percs slowly, excess sodium.	Severe: ponding.
KeA Kirley	Slight	Slight	Slight	Slight.
KeB Kirley	Slight	Slight	Moderate: slope.	Slight.
KeD Kirley	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
KfB*:				
Kirley	Slight	Slight	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
KfB*:				
Canning	Slight	Slight	Moderate: slope.	Slight.
KhA*:				
Kirley	Slight	Slight	Slight	Slight.
Mosher	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
KhB*:				
Kirley	Slight	Slight	Moderate: slope.	Slight.
Mosher	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
KmA*:				
Kirley	Slight	Slight	Slight	Slight.
Ottumwa	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Severe: erodes easily.
KmB*:				
Kirley	Slight	Slight	Moderate: slope.	Slight.
Ottumwa	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Severe: erodes easily.
KmC*:				
Kirley	Slight	Slight	Severe: slope.	Slight.
Ottumwa	Moderate: too clayey.	Moderate: too clayey.	Severe: slope.	Severe: erodes easily.
KnD*:				
Kirley	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Vivian	Moderate: slope.	Moderate: slope.	Severe: slope, small stones.	Slight.
Ko Kolls	Severe: wetness, percs slowly, too clayey.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness, percs slowly.	Severe: wetness, too clayey.
KyA Kyle	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey, percs slowly.	Severe: erodes easily.
KyB Kyle	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Severe: erodes easily.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
LaB: Lakoma	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey, slope, thin layer.	Moderate: too clayey.
LaC: Lakoma	Moderate: too clayey.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.
LaD: Lakoma	Moderate: slope, too clayey.	Moderate: slope, too clayey.	Severe: slope.	Severe: erodes easily.
LbE*:				
Lakoma	Moderate: slope, too clayey.	Moderate: slope, too clayey.	Severe: slope.	Severe: erodes easily.
Vivian	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.
Lo: Lohmiller	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
Lp: Lohmiller	Severe: flooding.	Moderate: too clayey.	Moderate: flooding.	Moderate: too clayey.
Lv*:				
Lohmiller	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
Arvada	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Moderate: dusty.
MaE: Midway	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, erodes easily.
Mo: Mosher	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Nb: Nimbro	Severe: flooding.	Slight	Slight	Slight.
Nc: Nimbro	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
NuA: Nunn	Moderate: dusty.	Moderate: dusty.	Moderate: small stones, dusty.	Moderate: dusty.
NuB: Nunn	Moderate: dusty.	Moderate: dusty.	Moderate: slope, small stones, dusty.	Moderate: dusty.
NuC: Nunn	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
NxD*:				
Nunn	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
Nihill	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight.
ObE*:				
Okaton	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, erodes easily.
Lakoma	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
Oc Onita	Severe: wetness.	Slight	Moderate: wetness.	Slight.
OdB Opal	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey.	Severe: erodes easily.
OdC Opal	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Severe: slope.	Severe: erodes easily.
OdD Opal	Moderate: slope, percs slowly.	Moderate: slope, too clayey.	Severe: slope.	Severe: erodes easily.
OeB*:				
Opal	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey.	Severe: erodes easily.
Promise	Moderate: percs slowly.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Severe: erodes easily.
OeC*:				
Opal	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Severe: slope.	Severe: erodes easily.
Promise	Moderate: percs slowly.	Moderate: too clayey, percs slowly.	Severe: slope.	Severe: erodes easily.
Of* Orthents, clayey	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
Og* Orthents, gravelly	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
OtA: Ottumwa	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Severe: erodes easily.
OtB: Ottumwa	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Severe: erodes easily.
OvA*:				
Ottumwa	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Severe: erodes easily.
Capa	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
OwB*:				
Ottumwa	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Severe: erodes easily.
Lakoma	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey, slope, thin layer.	Moderate: too clayey.
OwC*:				
Ottumwa	Moderate: too clayey.	Moderate: too clayey.	Severe: slope.	Severe: erodes easily.
Lakoma	Moderate: too clayey.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.
OxC*:				
Ottumwa	Moderate: too clayey.	Moderate: too clayey.	Severe: slope.	Severe: erodes easily.
Razor	Moderate: too clayey.	Moderate: too clayey.	Severe: slope.	Slight.
OyC*:				
Ottumwa	Moderate: too clayey.	Moderate: too clayey.	Severe: slope.	Severe: erodes easily.
Razor	Moderate: slope, too clayey.	Moderate: slope, too clayey.	Severe: slope.	Slight.
Savo	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.
PeC: Pierre	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Severe: slope.	Severe: erodes easily.
PeD: Pierre	Moderate: slope, percs slowly, too clayey.	Moderate: slope, too clayey, percs slowly.	Severe: slope.	Severe: erodes easily.
PkE*:				
Pierre	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
PkE*:				
Samsil	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: erodes easily.
PrA Promise	Moderate: percs slowly.	Moderate: too clayey, percs slowly.	Moderate: too clayey, percs slowly.	Severe: erodes easily.
PrB Promise	Moderate: percs slowly.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Severe: erodes easily.
RaB Razor	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Slight.
RaC Razor	Moderate: too clayey.	Moderate: too clayey.	Severe: slope.	Slight.
RbD*:				
Razor	Moderate: slope, too clayey.	Moderate: slope, too clayey.	Severe: slope.	Slight.
Midway	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
RdD*:				
Razor	Moderate: slope, too clayey.	Moderate: slope, too clayey.	Severe: slope.	Slight.
Shingle	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
ReA Ree	Slight	Slight	Slight	Slight.
ReB Ree	Slight	Slight	Moderate: slope.	Slight.
RfB*:				
Ree	Slight	Slight	Moderate: slope.	Slight.
Canning	Slight	Slight	Moderate: slope.	Slight.
RfC*:				
Ree	Slight	Slight	Severe: slope.	Slight.
Canning	Slight	Slight	Severe: slope.	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Rh*:				
Ree	Slight	Slight	Slight	Slight.
Hoven	Severe: ponding, percs slowly, excess sodium.	Severe: ponding, excess sodium, percs slowly.	Severe: ponding, percs slowly, excess sodium.	Severe: ponding.
RkD*:				
Ree	Slight	Slight	Severe: slope.	Slight.
Vivian	Moderate: slope.	Moderate: slope.	Severe: slope, small stones.	Slight.
Rv*. Riverwash	Severe: flooding, wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness, flooding.	Severe: wetness, too sandy.
SbF. Samsil	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, erodes easily.
ScF*:				
Samsil	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, erodes easily.
Nihill	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.
SdF*:				
Samsil	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, erodes easily.
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
SoE*:				
Sansarc	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, erodes easily.
Opal	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
SrA. Savo	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
SrB. Savo	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
SrC------------------- Savo	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.
StF*:				
Schamber-------------	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.
Samsil---------------	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, erodes easily.
SuE------------------ Shingle	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
SwE*:				
Shingle--------------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
Razor----------------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Wc------------------- Wendte	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
Wd*:				
Wendte---------------	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey, flooding.	Moderate: too clayey.
Herdcamp-------------	Severe: flooding, wetness, too clayey.	Severe: wetness, too clayey.	Severe: too clayey, wetness, flooding.	Severe: wetness, too clayey.
WsE*:				
Wendte---------------	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey, flooding.	Moderate: too clayey.
Sansarc--------------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, erodes easily.
Ww*:				
Wortman--------------	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Moderate: dusty.
Wanblee--------------	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Moderate: dusty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor")

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Planted trees and shrubs	Native deciduous trees	Native coniferous plants	Native shrubs	Wetland plants	Shallow water areas
Ab: Albaton	Poor	Poor	Good	Very poor.	Fair	Very poor.	Very poor.	Fair	Good.
Ar: Arvada	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor	Very poor.	Very poor.	Very poor.
As*:									
Arvada	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Slickspots	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Bc: Bankard	Very poor.	Very poor.	Fair	Poor	Fair	Fair	Fair	Poor	Very poor.
Bd: Bankard	Very poor.	Very poor.	Fair	Poor	Fair	Fair	Fair	Poor	Poor.
BkA, BkB: Blackpipe	Good	Good	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.
Bo*:									
Blackpipe	Good	Good	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.
Wortman	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Very poor.	Very poor.
Bu: Bullcreek	Very poor.	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.
Bx*:									
Bullcreek	Very poor.	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.
Slickspots	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Ca: Canning	Fair	Fair	Good	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.
CbA: Capa	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Cc*:									
Capa	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Slickspots	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Ct*:									
Capa	Very poor.	Very poor.	Poor	Very poor.	Very poor	Very poor.	Very poor.	Very poor.	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Planted trees and shrubs	Native deciduous trees	Native coniferous plants	Native shrubs	Wetland plants	Shallow water areas
	Potential for habitat elements								
Ct*:									
Wendte	Very poor.	Very poor.	Good	Fair	Poor	Very poor.	Fair	Poor	Very poor.
Cv Craft	Good	Good	Good	Good	Fair	Fair	Fair	Poor	Very poor.
Eg Egas	Very poor.	Very poor.	Fair	Very poor.	Poor	Very poor.	Very poor.	Poor	Poor.
Ha Haverson	Good	Good	Good	Good	Fair	Poor	Fair	Very poor.	Very poor.
Hb Haverson	Very poor.	Very poor.	Good	Good	Fair	Poor	Fair	Poor	Very poor.
Hc*:									
Haverson	Good	Good	Good	Good	Fair	Poor	Fair	Very poor.	Very poor.
Craft	Good	Good	Good	Good	Fair	Fair	Fair	Poor	Very poor.
Ho Hilmoe	Fair	Fair	Good	Fair	Fair	Fair	Fair	Poor	Very poor.
HpB Hisle	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Hv Hoven	Very poor.	Poor	Poor	Very poor.	Poor	Very poor.	Very poor.	Fair	Fair.
KeA, KeB Kirley	Good	Good	Good	Good	Fair	Very poor.	Fair	Very poor.	Very poor.
KeD Kirley	Poor	Good	Good	Good	Poor	Very poor.	Fair	Very poor.	Very poor.
KfB*:									
Kirley	Good	Good	Good	Good	Fair	Very poor.	Fair	Very poor.	Very poor.
Canning	Fair	Fair	Good	Poor	Poor	Very poor.	Poor	Very poor.	Very poor.
KhA*, KhB*:									
Kirley	Good	Good	Good	Good	Fair	Very poor.	Poor	Very poor.	Very poor.
Mosher	Poor	Poor	Poor	Poor	Poor	Very poor.	Poor	Very poor.	Very poor.
KmA*, KmB*:									
Kirley	Good	Good	Good	Good	Fair	Very poor.	Fair	Very poor.	Very poor.
Ottumwa	Fair	Fair	Good	Fair	Fair	Very poor.	Poor	Very poor.	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Planted trees and shrubs	Native deciduous trees	Native coniferous plants	Native shrubs	Wetland plants	Shallow water areas
KmC*:									
Kirley	Fair	Good	Good	Good	Fair	Very poor.	Fair	Very poor.	Very poor.
Ottumwa	Fair	Fair	Good	Fair	Fair	Very poor.	Poor	Very poor.	Very poor.
KnD*:									
Kirley	Poor	Good	Good	Good	Poor	Very poor.	Fair	Very poor.	Very poor.
Vivian	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Very poor.
Ko Kolls	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Fair	Fair.
KyA, KyB Kyle	Fair	Fair	Good	Fair	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
LaB Lakoma	Fair	Fair	Fair	Poor	Poor	Very poor.	Poor	Very poor.	Very poor.
LaC Lakoma	Poor	Fair	Fair	Poor	Poor	Very poor.	Poor	Very poor.	Very poor.
LaD Lakoma	Very poor.	Fair	Fair	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.
LbE*:									
Lakoma	Very poor.	Fair	Fair	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.
Vivian	Very poor.	Very poor.	Fair	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.
Lo Lohmiller	Good	Good	Good	Good	Poor	Poor	Poor	Very poor.	Very poor.
Lp Lohmiller	Very poor.	Very poor.	Good	Good	Fair	Poor	Fair	Poor	Very poor.
Lv*:									
Lohmiller	Good	Good	Good	Good	Poor	Poor	Poor	Very poor.	Very poor.
Arvada	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
MaE Midway	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Very poor.
Mo Mosher	Poor	Poor	Poor	Poor	Poor	Very poor.	Poor	Very poor.	Very poor.
Nb Nimbro	Good	Good	Good	Good	Fair	Very poor.	Fair	Very poor.	Very poor.
Nc Nimbro	Very poor.	Very poor.	Good	Good	Fair	Very poor.	Fair	Poor	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Planted trees and shrubs	Native deciduous trees	Native coniferous plants	Native shrubs	Wetland plants	Shallow water areas
NuA, NuB: Nunn	Good	Good	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.
NuC: Nunn	Fair	Good	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.
NxD*:									
Nunn	Poor	Good	Good	Good	Poor	Poor	Poor	Very poor.	Very poor.
Nihill	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Very poor.
ObE*:									
Okaton	Very poor.	Very poor.	Fair	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.
Lakoma	Very poor.	Very poor.	Fair	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.
Oc: Onita	Good	Good	Good	Good	Fair	Poor	Fair	Very poor.	Very poor.
OdB: Opal	Fair	Fair	Good	Fair	Fair	Very poor.	Poor	Very poor.	Very poor.
OdC: Opal	Poor	Fair	Good	Fair	Fair	Very poor.	Poor	Very poor.	Very poor.
OdD: Opal	Very poor.	Fair	Good	Fair	Poor	Very poor.	Very poor.	Very poor.	Very poor.
OeB*:									
Opal	Fair	Fair	Good	Fair	Fair	Very poor.	Poor	Very poor.	Very poor.
Promise	Fair	Fair	Good	Fair	Fair	Very poor.	Poor	Very poor.	Very poor.
OeC*:									
Opal	Poor	Fair	Good	Fair	Fair	Very poor.	Poor	Very poor.	Very poor.
Promise	Poor	Fair	Good	Fair	Fair	Very poor.	Poor	Very poor.	Very poor.
Of*: Orthents, clayey	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Og*: Orthents, gravelly	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
OtA, OtB: Ottumwa	Fair	Fair	Good	Fair	Fair	Very poor.	Fair	Very poor.	Very poor.
OvA*:									
Ottumwa	Fair	Fair	Good	Fair	Fair	Very poor.	Fair	Very poor.	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Planted trees and shrubs	Native deciduous trees	Native coniferous plants	Native shrubs	Wetland plants	Shallow water areas
OvA*:									
Capa	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
OwB*:									
Ottumwa	Fair	Fair	Good	Fair	Fair	Very poor.	Fair	Very poor.	Very poor.
Lakoma	Fair	Fair	Fair	Poor	Poor	Very poor.	Poor	Very poor.	Very poor.
OwC*:									
Ottumwa	Fair	Fair	Good	Fair	Fair	Very poor.	Fair	Very poor.	Very poor.
Lakoma	Poor	Fair	Fair	Poor	Poor	Very poor.	Poor	Very poor.	Very poor.
OxC*:									
Ottumwa	Poor	Fair	Good	Fair	Fair	Very poor.	Fair	Very poor.	Very poor.
Razor	Poor	Fair	Good	Fair	Fair	Very poor.	Fair	Very poor.	Very poor.
OyC*:									
Ottumwa	Fair	Fair	Good	Fair	Fair	Very poor.	Fair	Very poor.	Very poor.
Razor	Very poor.	Fair	Good	Fair	Poor	Very poor.	Fair	Very poor.	Very poor.
Savo	Fair	Good	Good	Good	Fair	Poor	Fair	Very poor.	Very poor.
PeC Pierre	Poor	Fair	Good	Fair	Poor	Very poor.	Poor	Very poor.	Very poor.
PeD Pierre	Very poor.	Fair	Good	Fair	Poor	Very poor.	Very poor.	Very poor.	Very poor.
PkE*:									
Pierre	Very poor.	Very poor.	Good	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Samsil	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
PrA, PrB Promise	Fair	Fair	Good	Fair	Fair	Very poor.	Poor	Very poor.	Very poor.
RaB, RaC Razor	Poor	Fair	Good	Fair	Fair	Very poor.	Poor	Very poor.	Very poor.
RbD*:									
Razor	Very poor.	Fair	Good	Fair	Poor	Very poor.	Poor	Very poor.	Very poor.
Midway	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Planted trees and shrubs	Native deciduous trees	Native coniferous plants	Native shrubs	Wetland plants	Shallow water areas
RdD*:									
Razor	Very poor.	Fair	Good	Fair	Poor	Very poor.	Very poor.	Very poor.	Very poor.
Shingle	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
ReA, ReB Ree	Good	Good	Good	Good	Fair	Poor	Very poor.	Very poor.	Very poor.
RfB*:									
Ree	Good	Good	Good	Good	Fair	Poor	Fair	Very poor.	Very poor.
Canning	Fair	Fair	Good	Poor	Poor	Poor	Poor	Very poor.	Very poor.
RfC*:									
Ree	Fair	Good	Good	Good	Fair	Poor	Fair	Very poor.	Very poor.
Canning	Poor	Fair	Good	Poor	Poor	Poor	Poor	Very poor.	Very poor.
Rh*:									
Ree	Good	Good	Good	Good	Fair	Poor	Fair	Very poor.	Very poor.
Hoven	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Fair	Fair.
RkD*:									
Ree	Fair	Good	Good	Good	Fair	Poor	Poor	Very poor.	Very poor.
Vivian	Very poor.	Very poor.	Fair	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.
Rv* Riverwash	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
SbF Samsil	Very poor.	Very poor.	Fair	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.
ScF*:									
Samsil	Very poor.	Very poor.	Fair	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.
Nihill	Very poor.	Very poor.	Poor	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.
SdF*:									
Samsil	Very poor.	Very poor.	Fair	Very poor.	Poor	Poor	Poor	Very poor.	Very poor.
Rock outcrop	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Planted trees and shrubs	Native deciduous trees	Native coniferous plants	Native shrubs	Wetland plants	Shallow water areas
SoE*:									
Sansarc	Very poor.	Very poor.	Fair	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.
Opal	Very poor.	Very poor.	Good	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.
SrA, SrB Savo	Good	Good	Good	Good	Fair	Poor	Fair	Very poor.	Very poor.
SrC Savo	Fair	Good	Good	Good	Fair	Poor	Fair	Very poor.	Very poor.
StF*:									
Schamber	Very poor.	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.
Samsil	Very poor.	Very poor.	Fair	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.
SuE Shingle	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
SwE*:									
Shingle	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Razor	Very poor.	Very poor.	Good	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.
Wc Wendte	Fair	Fair	Good	Fair	Poor	Poor	Poor	Poor	Very poor.
Wd*:									
Wendte	Very poor.	Very poor.	Good	Fair	Poor	Very poor.	Poor	Poor	Very poor.
Herdcamp	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Fair	Fair.
WsE*:									
Wendte	Very poor.	Very poor.	Good	Fair	Poor	Very poor.	Poor	Poor	Very poor.
Sansarc	Very poor.	Very poor.	Fair	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.
Ww*:									
Wortman	Poor	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.
Wanblee	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ab----------------- Albaton	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.
Ar----------------- Arvada	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
As*:					
Arvada-----------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Slickspots-------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.
Bc----------------- Bankard	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Bd----------------- Bankard	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
BkA--------------- Blackpipe	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
BkB--------------- Blackpipe	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Bo*:					
Blackpipe--------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Wortman----------	Slight-----------	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.
Bu----------------- Bullcreek	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Bx*:					
Bullcreek--------	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Slickspots-------	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ca: Canning	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.
CbA: Capa	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Cc*:					
Capa	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Slickspots	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.
Ct*:					
Capa	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Wendte	Moderate: too clayey, wetness, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.
Cv: Craft	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Eg: Egas	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.
Ha: Haverson	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: shrink-swell, flooding.
Hb: Haverson	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Hc*:					
Haverson	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: shrink-swell, flooding.
Craft	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Ho: Hilmoe	Moderate: too clayey.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: shrink-swell, low strength, flooding.
HpB: Hisle	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Hv---------------- Hoven	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.
KeA, KeB---------- Kirley	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
KeD--------------- Kirley	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.
KfB*:					
Kirley-----------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Canning----------	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight-----------	Moderate: shrink-swell, slope.	Moderate: low strength, shrink-swell.
KhA*, KhB*:					
Kirley-----------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Mosher-----------	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
KmA*, KmB*, KmC*:					
Kirley-----------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Ottumwa----------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
KnD*:					
Kirley-----------	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.
Vivian-----------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Ko---------------- Kolls	Severe: cutbanks cave, wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.
KyA, KyB---------- Kyle	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
LaB, LaC---------- Lakoma	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
LaD: Lakoma	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.
LbE*:					
Lakoma	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.
Vivian	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Lo: Lohmiller	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength.
Lp: Lohmiller	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.
Lv*:					
Lohmiller	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength.
Arvada	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
MaE: Midway	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.
Mo: Mosher	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Nb: Nimbro	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Nc: Nimbro	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
NuA, NuB, NuC: Nunn	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
NxD*:					
Nunn	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.
Nihill	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
ObE*:					
Okaton	Severe: slope.	Severe: slope.	Severe: slope, shrink-swell.	Severe: slope.	Severe: slope.
Lakoma	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.
Oc: Onita	Moderate: too clayey, wetness.	Severe: wetness.	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness, low strength.
OdB, OdC: Opal	Severe: cutbanks cave.	Severe: shrink-swell.	Moderate: depth to rock.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
OdD: Opal	Severe: cutbanks cave.	Severe: shrink-swell.	Moderate: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.
OeB*, OeC*:					
Opal	Severe: cutbanks cave.	Severe: shrink-swell.	Moderate: depth to rock.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Promise	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Of*: Orthents, clayey	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: low strength.
Og*: Orthents, gravelly	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
OtA, OtB: Ottumwa	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
OvA*:					
Ottumwa	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Capa	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
OwB*, OwC*:					
Ottumwa	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Lakoma	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
OxC*:					
Ottumwa	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Razor	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
OyC*:					
Ottumwa	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Razor	Moderate: depth to rock, too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.
Savo	Slight	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
PeC Pierre	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
PeD Pierre	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.
PkE*:					
Pierre	Severe: cutbanks cave, slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.
Samsil	Severe: slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: low strength, slope, shrink-swell.
PrA, PrB Promise	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
RaB, RaC Razor	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
RbD*:					
Razor	Moderate: depth to rock, too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.
Midway	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
RdD*:					
Razor	Moderate: depth to rock, too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.
Shingle	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: low strength.
ReA Ree	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
ReB Ree	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
RfB*, RfC*:					
Ree	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Canning	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Moderate: low strength, shrink-swell.
Rh*:					
Ree	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Hoven	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.
RkD*:					
Ree	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Vivian	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Rv* Riverwash	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.
SbF Samsil	Severe: slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: low strength, slope, shrink-swell.
ScF*:					
Samsil	Severe: slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: low strength, slope, shrink-swell.
Nihill	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
SdF*:					
Samsil-----------	Severe: slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: low strength, slope, shrink-swell.
Rock outcrop-----	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.
SoE*:					
Sansarc----------	Severe: depth to rock, slope.	Severe: slope, shrink-swell.	Severe: depth to rock, slope, shrink-swell.	Severe: slope, shrink-swell.	Severe: low strength, slope, shrink-swell.
Opal-------------	Severe: cutbanks cave, slope.	Severe: shrink-swell, slope.	Severe: slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.
SrA, SrB, SrC----- Savo	Slight----------	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
StF*:					
Schamber---------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Samsil-----------	Severe: slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: low strength, slope, shrink-swell.
SuE--------------- Shingle	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: low strength, slope.
SwE*:					
Shingle----------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: low strength, slope.
Razor------------	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.
Wc---------------- Wendte	Moderate: too clayey, wetness.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength.
Wd*:					
Wendte-----------	Moderate: too clayey, wetness, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Wd*:					
Herdcamp	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.
WsE*:					
Wendte	Moderate: too clayey, wetness, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.
Sansarc	Severe: depth to rock, slope.	Severe: slope, shrink-swell.	Severe: depth to rock, slope, shrink-swell.	Severe: slope, shrink-swell.	Severe: low strength, slope, shrink-swell.
Ww*:					
Wortman	Slight	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.
Wanblee	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ab: Albaton	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding.	Severe: flooding, ponding, too clayey.	Severe: flooding, ponding.	Poor: too clayey, hard to pack, ponding.
Ar: Arvada	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Good.
As*:					
Arvada	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Good.
Slickspots	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, excess salt.
Bc: Bankard	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Moderate: flooding.	Poor: seepage, too sandy.
Bd: Bankard	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, too sandy.	Severe: flooding.	Poor: seepage, too sandy.
BkA, BkB: Blackpipe	Severe: seepage, thin layer.	Severe: seepage.	Severe: seepage.	Slight	Poor: area reclaim, thin layer.
Bo*:					
Blackpipe	Severe: seepage, thin layer.	Severe: seepage.	Severe: seepage.	Slight	Poor: area reclaim, thin layer.
Wortman	Severe: thin layer, seepage, percs slowly.	Severe: seepage.	Severe: seepage, excess sodium.	Slight	Poor: area reclaim, excess sodium, thin layer.
Bu: Bullcreek	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Bx*:					
Bullcreek	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Slickspots	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock, too clayey, excess salt.	Moderate: depth to rock.	Poor: too clayey, excess salt.
Ca: Canning	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, small stones.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
CbA: Capa	Severe: wetness, percs slowly.	Moderate: slope.	Severe: too clayey, excess sodium.	Slight	Poor: too clayey, hard to pack, excess sodium.
Cc*:					
Capa	Severe: wetness, percs slowly.	Slight	Severe: too clayey, excess sodium.	Slight	Poor: too clayey, hard to pack, excess sodium.
Slickspots	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock, too clayey, excess salt.	Moderate: depth to rock.	Poor: too clayey, excess salt.
Ct*:					
Capa	Severe: wetness, percs slowly.	Moderate: slope.	Severe: too clayey, excess sodium.	Slight	Poor: too clayey, hard to pack, excess sodium.
Wendte	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
Cv: Craft	Moderate: flooding, percs slowly.	Severe: seepage.	Moderate: flooding, too sandy.	Moderate: flooding.	Good.
Eg: Egas	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
Ha: Haverson	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Hb: Haverson	Severe: flooding.	Severe: flooding.	Severe: flooding, too sandy.	Severe: flooding.	Poor: too sandy.
Hc*:					
Haverson	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Craft	Moderate: flooding, percs slowly.	Severe: seepage.	Moderate: flooding, too sandy.	Moderate: flooding.	Good.
Ho: Hilmoe	Severe: percs slowly.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
HpB: Hisle	Severe: thin layer, seepage, percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Poor: area reclaim, hard to pack, thin layer.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Hv------------------ Hoven	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey, excess sodium.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
KeA----------------- Kirley	Severe: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
KeB----------------- Kirley	Severe: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
KeD----------------- Kirley	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
KfB*:					
Kirley-------------	Severe: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Canning------------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, small stones.
KhA*:					
Kirley-------------	Severe: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Mosher-------------	Severe: wetness, percs slowly.	Moderate: seepage.	Severe: too clayey, excess sodium.	Slight-----------	Poor: too clayey, hard to pack, excess sodium.
KhB*:					
Kirley-------------	Severe: percs slowly.	Moderate: slope, seepage.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Mosher-------------	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Severe: too clayey, excess sodium.	Slight-----------	Poor: too clayey, hard to pack, excess sodium.
KmA*:					
Kirley-------------	Severe: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Ottumwa------------	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
KmB*:					
Kirley-------------	Severe: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
KmB*:					
Ottumwa	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
KmC*:					
Kirley	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Ottumwa	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
KnD*:					
Kirley	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
Vivian	Moderate: depth to rock, slope.	Severe: seepage, slope.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: small stones.
Ko: Kolls	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
KyA: Kyle	Severe: percs slowly.	Slight	Slight	Slight	Poor: hard to pack.
KyB: Kyle	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Poor: hard to pack.
LaB: Lakoma	Severe: thin layer, seepage.	Severe: seepage.	Severe: seepage.	Moderate: seepage.	Poor: area reclaim, too clayey, hard to pack.
LaC: Lakoma	Severe: thin layer, seepage.	Severe: seepage, slope.	Severe: seepage.	Moderate: seepage.	Poor: area reclaim, too clayey, hard to pack.
LaD: Lakoma	Severe: thin layer, seepage.	Severe: seepage, slope.	Severe: seepage.	Moderate: seepage, slope.	Poor: area reclaim, too clayey, hard to pack.
LbE*:					
Lakoma	Severe: thin layer, seepage.	Severe: seepage, slope.	Severe: seepage.	Moderate: seepage, slope.	Poor: area reclaim, too clayey, hard to pack.
Vivian	Severe: slope.	Severe: seepage, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, slope.	Poor: small stones, slope.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Lo: Lohmiller	Severe: percs slowly.	Slight	Moderate: flooding.	Moderate: flooding.	Poor: hard to pack.
Lp: Lohmiller	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Poor: hard to pack.
Lv*:					
Lohmiller	Severe: percs slowly.	Slight	Moderate: flooding.	Moderate: flooding.	Poor: hard to pack.
Arvada	Severe: percs slowly.	Slight	Slight	Slight	Good.
MaE: Midway	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
Mo: Mosher	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Severe: too clayey, excess sodium.	Slight	Poor: hard to pack, excess sodium.
Nb: Nimbro	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Nc: Nimbro	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Fair: too clayey.
NuA: Nunn	Severe: percs slowly.	Slight	Slight	Slight	Poor: hard to pack.
NuB: Nunn	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Poor: hard to pack.
NuC: Nunn	Severe: percs slowly.	Severe: slope.	Slight	Slight	Poor: hard to pack.
NxD*:					
Nunn	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: hard to pack.
Nihill	Moderate: slope.	Severe: seepage, slope.	Moderate: slope.	Moderate: slope.	Poor: small stones.
ObE*:					
Okaton	Severe: thin layer, seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: area reclaim, too clayey, hard to pack.
Lakoma	Severe: thin layer, seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: slope.	Poor: area reclaim, too clayey, hard to pack.
Oc: Onita	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
OdB----------------- Opal	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
OdC, OdD------------ Opal	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
OeB*:					
Opal---------------	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Promise------------	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
OeC*:					
Opal---------------	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Promise------------	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Of*----------------- Orthents, clayey	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock.	Poor: depth to rock, hard to pack.
Og*----------------- Orthents, gravelly	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
OtA----------------- Ottumwa	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
OtB----------------- Ottumwa	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
OvA*:					
Ottumwa------------	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
Capa---------------	Severe: wetness, percs slowly.	Slight-----------	Severe: too clayey, excess sodium.	Slight-----------	Poor: too clayey, hard to pack, excess sodium.
OwB*:					
Ottumwa------------	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
OwB*:					
Lakoma	Severe: thin layer, seepage.	Severe: seepage.	Severe: seepage.	Moderate: seepage.	Poor: area reclaim, too clayey, hard to pack.
OwC*:					
Ottumwa	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
Lakoma	Severe: thin layer, seepage.	Severe: seepage, slope.	Severe: seepage.	Moderate: seepage.	Poor: area reclaim, too clayey, hard to pack.
OxC*:					
Ottumwa	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
Razor	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Slight	Poor: depth to rock, hard to pack.
OyC*:					
Ottumwa	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
Razor	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock, hard to pack.
Savo	Severe: percs slowly.	Severe: slope.	Slight	Slight	Poor: hard to pack.
PeC Pierre	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Slight	Poor: depth to rock.
PeD Pierre	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock.
PkE*:					
Pierre	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
Samsil	Severe: thin layer, seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope	Severe: slope.	Poor: area reclaim, hard to pack, slope.
PrA Promise	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
PrB----------------- Promise	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
RaB----------------- Razor	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Slight-----------	Poor: depth to rock, hard to pack.
RaC----------------- Razor	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Slight-----------	Poor: depth to rock, hard to pack.
RbD*:					
Razor---------------	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock, hard to pack.
Midway--------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock.
RdD*:					
Razor---------------	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock, hard to pack.
Shingle-------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock.
ReA----------------- Ree	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight-----------	Poor: thin layer.
ReB----------------- Ree	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight-----------	Poor: thin layer.
RfB*:					
Ree-----------------	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight-----------	Poor: thin layer.
Canning-------------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, small stones.
RfC*:					
Ree-----------------	Moderate: percs slowly.	Severe: seepage, slope.	Severe: seepage.	Slight-----------	Poor: thin layer.
Canning-------------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, small stones.
Rh*:					
Ree-----------------	Moderate: percs slowly.	Severe: seepage.	Severe: too clayey, seepage.	Slight-----------	Poor: thin layer.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Rh*:					
Hoven	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey, excess sodium.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
RkD*:					
Ree	Moderate: percs slowly.	Severe: seepage, slope.	Severe: seepage.	Slight	Poor: thin layer.
Vivian	Moderate: depth to rock, slope.	Severe: seepage, slope.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: small stones.
Rv*. Riverwash	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
SbF Samsil	Severe: thin layer, seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: slope.	Poor: area reclaim, hard to pack, slope.
ScF*:					
Samsil	Severe: thin layer, seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: slope.	Poor: area reclaim, hard to pack, slope.
Nihill	Severe: slope.	Severe: seepage, slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.
SdF*:					
Samsil	Severe: thin layer, seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: slope.	Poor: area reclaim, hard to pack, slope.
Rock outcrop	Severe: depth to rock, slope, seepage.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: depth to rock, slope, seepage.
SoE*:					
Sansarc	Severe: depth to rock, slope, seepage.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, slope.	Poor: depth to rock, hard to pack, slope.
Opal	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
SrA Savo	Severe: percs slowly.	Moderate: seepage.	Slight	Slight	Poor: hard to pack.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
SrB------------------ Savo	Severe: percs slowly.	Moderate: seepage, slope.	Slight-----------	Slight-----------	Poor: hard to pack.
SrC------------------ Savo	Severe: percs slowly.	Severe: slope.	Slight-----------	Slight-----------	Poor: hard to pack.
StF*:					
Schamber------------	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: slope.	Poor: seepage, too sandy, small stones.
Samsil-------------	Severe: thin layer, seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: slope.	Poor: area reclaim, hard to pack, slope.
SuE------------------ Shingle	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
SwE*:					
Shingle------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
Razor--------------	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, hard to pack, slope.
Wc------------------ Wendte	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey.	Moderate: flooding, wetness.	Poor: too clayey, hard to pack.
Wd*:					
Wendte-------------	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
Herdcamp-----------	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
WsE*:					
Wendte-------------	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
Sansarc------------	Severe: depth to rock, slope, seepage.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, slope.	Poor: depth to rock, hard to pack, slope.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ww*:					
Wortman------------	Severe: thin layer, seepage, percs slowly.	Severe: seepage.	Severe: seepage, excess sodium.	Slight-----------	Poor: area reclaim, excess sodium, thin layer.
Wanblee------------	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Slight-----------	Poor: depth to rock.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ab-------------------- Albaton	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Ar-------------------- Arvada	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess sodium.
As*: Arvada---------------	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess sodium.
Slickspots-----------	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt.
Bc-------------------- Bankard	Good-----------------	Probable-------------	Probable-------------	Poor: too sandy, small stones.
Bd-------------------- Bankard	Good-----------------	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy, small stones, area reclaim.
BkA, BkB-------------- Blackpipe	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Bo*: Blackpipe------------	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Wortman--------------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Bu-------------------- Bullcreek	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt.
Bx*: Bullcreek------------	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt.
Slickspots-----------	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt.
Ca-------------------- Canning	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
CbA Capa	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.
Cc*:				
Capa	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.
Slickspots	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt.
Ct*:				
Capa	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.
Wendte	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Cv Craft	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
Eg Egas	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
Ha Haverson	Good	Probable	Probable	Fair: too clayey, small stones.
Hb Haverson	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
Hc*:				
Haverson	Good	Probable	Probable	Fair: too clayey, small stones.
Craft	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
Ho Hilmoe	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
HpB Hisle	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Hv: Hoven	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
KeA, KeB, KeD: Kirley	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
KfB*:				
Kirley	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Canning	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
KhA*, KhB*:				
Kirley	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Mosher	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.
KmA*, KmB*, KmC*:				
Kirley	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Ottumwa	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
KnD*:				
Kirley	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Vivian	Fair: depth to rock, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Ko: Kolls	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
KyA, KyB: Kyle	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
LaB, LaC, LaD: Lakoma	Poor: area reclaim, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
LbE*:				
Lakoma	Poor: area reclaim, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Vivian	Fair: depth to rock, thin layer, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Lo Lohmiller	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Lp Lohmiller	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Lv*:				
Lohmiller	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Arvada	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess sodium.
MaE Midway	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, slope.
Mo Mosher	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.
Nb, Nc Nimbro	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
NuA, NuB, NuC Nunn	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
NxD*:				
Nunn	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Nihill	Good	Improbable: small stones.	Probable	Poor: small stones, area reclaim.
ObE*:				
Okaton	Poor: area reclaim, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey, thin layer.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
ObE*:				
Lakoma	Poor: area reclaim, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
Oc Onita	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
OdB, OdC, OdD Opal	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
OeB*, OeC*:				
Opal	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Promise	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Of* Orthents, clayey	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
Og* Orthents, gravelly	Poor: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
OtA, OtB Ottumwa	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
OvA*:				
Ottumwa	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Capa	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.
OwB*, OwC*:				
Ottumwa	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Lakoma	Poor: area reclaim, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
OxC*:				
Ottumwa	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
OxC*:				
Razor	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
OyC*:				
Ottumwa	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Razor	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Savo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
PeC, PeD Pierre	Poor: depth to rock, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
PkE*:				
Pierre	Poor: depth to rock, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
Samsil	Poor: area reclaim, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, slope.
PrA, PrB Promise	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
RaB, RaC Razor	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
RbD*:				
Razor	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Midway	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey.
RdD*:				
Razor	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
RdD*:				
Shingle	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
ReA, ReB: Ree	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, thin layer.
RfB*, RfC*:				
Ree	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, thin layer.
Canning	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Rh*:				
Ree	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, thin layer.
Hoven	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
RkD*:				
Ree	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, thin layer.
Vivian	Fair: depth to rock, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Rv*: Riverwash	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
SbF: Samsil	Poor: area reclaim, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, slope.
ScF*:				
Samsil	Poor: area reclaim, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, slope.
Nihill	Poor: slope.	Improbable: small stones.	Probable	Poor: small stones, area reclaim, slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
SdF*:				
Samsil	Poor: area reclaim, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, slope.
Rock outcrop	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, area reclaim, slope.
SoE*:				
Sansarc	Poor: depth to rock, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Opal	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
SrA, SrB, SrC Savo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
StF*:				
Schamber	Poor: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Samsil	Poor: area reclaim, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, slope.
SuE Shingle	Poor: depth to rock, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
SwE*:				
Shingle	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
Razor	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
Wc Wendte	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Wd*:				
Wendte	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Wd*:				
Herdcamp-------------	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
WsE*:				
Wendte---------------	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Sansarc--------------	Poor: depth to rock, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Ww*:				
Wortman--------------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Wanblee--------------	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
Ab Albaton	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly, flooding.	Ponding, slow intake, percs slowly.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
Ar Arvada	Slight	Severe: excess sodium.	Deep to water	Droughty	Erodes easily	Too arid, excess sodium.
As*:						
Arvada	Slight	Severe: excess sodium.	Deep to water	Droughty	Erodes easily	Too arid, excess sodium.
Slickspots	Moderate: depth to rock.	Severe: excess salt.	Deep to water	Droughty, excess salt.	Erodes easily, percs slowly.	Excess salt, erodes easily, percs slowly.
Bc Bankard	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Too arid, droughty.
Bd Bankard	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Too arid, droughty, rooting depth.
BkA Blackpipe	Moderate: seepage.	Severe: thin layer.	Deep to water	Thin layer	Area reclaim	Area reclaim.
BkB Blackpipe	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Slope, thin layer.	Area reclaim	Area reclaim.
Bo*:						
Blackpipe	Moderate: seepage.	Severe: thin layer.	Deep to water	Thin layer	Area reclaim	Area reclaim.
Wortman	Moderate: seepage.	Severe: piping, excess sodium.	Deep to water	Percs slowly, thin layer.	Area reclaim	Excess sodium, area reclaim, percs slowly.
Bu Bullcreek	Moderate: slope.	Severe: hard to pack.	Deep to water	Slope. droughty, slow intake.	Erodes easily, percs slowly.	Erodes easily, droughty.
Bx*:						
Bullcreek	Slight	Severe: hard to pack.	Deep to water	Droughty, slow intake.	Erodes easily, percs slowly.	Erodes easily, droughty.
Slickspots	Moderate: depth to rock.	Severe: excess salt.	Deep to water	Droughty, excess salt.	Erodes easily, percs slowly.	Excess salt, erodes easily, percs slowly.
Ca Canning	Severe: seepage.	Severe: seepage.	Deep to water	Rooting depth	Too sandy	Rooting depth.
CbA Capa	Moderate: slope.	Severe: hard to pack, excess sodium.	Deep to water	Slope, droughty, percs slowly.	Erodes easily, percs slowly.	Excess sodium, erodes easily, droughty.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Cc*:						
Capa	Slight	Severe: hard to pack, excess sodium.	Deep to water	Droughty, percs slowly.	Erodes easily, percs slowly.	Excess sodium, erodes easily, droughty.
Slickspots	Moderate: depth to rock.	Severe: excess salt.	Deep to water	Droughty, excess salt.	Erodes easily, percs slowly.	Excess salt, erodes easily, percs slowly.
Ct*:						
Capa	Slight	Severe: hard to pack, excess sodium.	Deep to water	Droughty, percs slowly.	Erodes easily, percs slowly.	Excess sodium, erodes easily, droughty.
Wendte	Slight	Sevare: hard to pack.	Deep to water	Slow intake, percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Cv Craft	Severe: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily, soil blowing.	Too arid, erodes easily.
Eg Egas	Slight	Severe: hard to pack, wetness.	Percs slowly, flooding, frost action.	Wetness, droughty.	Erodes easily, wetness, percs slowly.	Wetness, excess salt, erodes easily.
Ha Haverson	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favvorable	Too arid.
Hb Haverson	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Too sandy	Too arid.
Hc*:						
Haverson	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Too arid.
Craft	Severe: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily, soil blowing.	Too arid, erodes easily.
Ho Hilmoe	Moderate: seepage.	Severe: piping.	Deep to water	Slow intake, percs slowly.	Erodes easily	Erodes easily, percs slowly.
HpB Hisle	Moderate: seepage, slope.	Severe: hard to pack, excess sodium.	Deep to water	Slope, droughty, percs slowly.	Area reclaim, erodes easily.	Excess sodium, erodes easily.
Hv Hoven	Slight	Severe: hard to pack, ponding, excess sodium.	Ponding, percs slowly, excess salt.	Ponding, percs slowly, erodes easily.	Erodes easily, ponding, percs slowly.	Wetness, excess sodium, erodes easily.
KeA Kirley	Moderate: seepage.	Severe: hard to pack.	Deep to water	Percs slowly	Erodes easily	Erodes easily, percs slowly.
KeB Kirley	Moderate: seepage, slope.	Severe; hard to pack.	Deep to water	Slope, percs slowly.	Erodes easily	Erodes easily, percs slowly.
KeD Kirley	Severe: slope.	Severe; hard to pack.	Deep to water	Slope, percs slowly.	Slope, erodes easily.	Slope, erodes easily, percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
KfB*:						
Kirley	Moderate: seepage, slope.	Severe: hard to pack.	Deep to water	Slope, percs slowly.	Erodes easily	Erodes easily, percs slowly.
Canning	Severe: seepage.	Severe: seepage.	Deep to water	Slope, rooting depth.	Too sandy	Rooting depth.
KhA*:						
Kirley	Moderate: seepage.	Severe: hard to pack.	Deep to water	Percs slowly	Erodes easily	Erodes easily, percs slowly.
Mosher	Moderate: seepage.	Severe: hard to pack, excess sodium.	Deep to water	Percs slowly	Erodes easily, percs slowly.	Excess sodium, erodes easily.
KhB*:						
Kirley	Moderate: seepage, slope.	Severe: hard to pack.	Deep to water	Slope, percs slowly.	Erodes easily	Erodes easily, percs slowly.
Mosher	Moderate: seepage, slope.	Severe: hard to pack, excess sodium.	Deep to water	Slope, percs slowly.	Erodes easily, percs slowly.	Excess sodium, erodes easily.
KmA*:						
Kirley	Moderate: seepage.	Severe: hard to pack.	Deep to water	Percs slowly	Erodes easily	Erodes easily, percs slowly.
Ottumwa	Moderate: depth to rock.	Severe: hard to pack.	Deep to water	Droughty, slow intake.	Erodes easily, percs slowly.	Erodes easily, droughty.
KmB*, KmC*:						
Kirley	Moderate: seepage, slope.	Severe: hard to pack.	Deep to water	Slope, percs slowly.	Erodes easily	Erodes easily, percs slowly.
Ottumwa	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Slope, droughty, slow intake.	Erodes easily, percs slowly.	Erodes easily, droughty.
KnD*:						
Kirley	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, percs slowly.	Slope, erodes easily.	Slope, erodes easily, percs slowly.
Vivian	Severe: seepage, slope.	Moderate: thin layer.	Deep to water	Slope, droughty.	Slope	Slope, droughty.
Ko Kolls	Slight	Severe: hard to pack, wetness.	Percs slowly	Wetness, droughty, slow intake.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, droughty.
KyA Kyle	Slight	Severe: hard to pack.	Deep to water	Droughty, slow intake.	Erodes easily, percs slowly.	Too arid, erodes easily.
KyB Kyle	Moderate: slope.	Severe: hard to pack.	Deep to water	Slope, droughty, slow intake.	Erodes easily, percs slowly.	Too arid, erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
LaB, LaC: Lakoma	Moderate: seepage, slope.	Severe: hard to pack.	Deep to water	Slope, droughty, slow intake.	Area reclaim, erodes easily.	Erodes easily, droughty.
LaD: Lakoma	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, droughty, slow intake.	Slope, area reclaim, erodes easily.	Slope, erodes easily, droughty.
LbE*:						
Lakoma	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, droughty, slow intake.	Slope, area reclaim, erodes easily.	Slope, erodes easily, droughty.
Vivian	Severe: seepage, slope.	Moderate: thin layer.	Deep to water	Slope, droughty.	Slope	Slope, droughty.
Lo: Lohmiller	Slight	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly.	Erodes easily, percs slowly.	Too arid, erodes easily, percs slowly.
Lp: Lohmiller	Slight	Moderate: thin layer, hard to pack.	Deep to water	Slow intake, percs slowly, flooding.	Erodes easily, percs slowly.	Too arid, erodes easily, percs slowly.
Lv*:						
Lohmiller	Slight	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly.	Erodes easily, percs slowly.	Too arid, erodes easily, percs slowly.
Arvada	Slight	Severe: excess sodium.	Deep to water	Droughty	Erodes easily	Too arid, excess sodium.
MaE: Midway	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Slope, percs slowly.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
Mo: Mosher	Moderate: seepage.	Severe: hard to pack, excess sodium.	Deep to water	Percs slowly	Erodes easily, percs slowly.	Excess sodium, erodes easily.
Nb: Nimbro	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable	Favorable.
Nc: Nimbro	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding	Favorable	Favorable.
NuA: Nunn	Slight	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly	Erodes easily	Too arid, erodes easily.
NuB, NuC: Nunn	Moderate: slope.	Moderate: thin layer, hard to pack.	Deep to water	Slope, percs slowly.	Erodes easily	Too arid, erodes easily.
NxD*:						
Nunn	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Slope, percs slowly.	Slope, erodes easily.	Too arid, slope, erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
NxD*:						
Nihill	Severe: seepage, slope.	Moderate: thin layer.	Deep to water	Slope, droughty.	Slope	Too arid, slope, droughty.
ObE*:						
Okaton	Severe: seepage, slope.	Severe: hard to pack, thin layer.	Deep to water	Slope, slow intake, percs slowly.	Slope, area reclaim, erodes easily.	Slope, erodes easily, area reclaim.
Lakoma	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, droughty, slow intake.	Slope, area reclaim, erodes easily.	Slope, erodes easily, droughty.
Oc Onita	Slight	Moderate: piping, hard to pack, wetness.	Frost action, wetness.	Wetness	Erodes easily, wetness.	Erodes easily.
OdB, OdC Opal	Moderate: depth to rock, slope.	Slight	Deep to water	Slope, droughty, slow intake.	Depth to rock, erodes easily.	Erodes easily, droughty.
OdD Opal	Severe: slope.	Slight	Deep to water	Slope, droughty, slow intake.	Slope, depth to rock, erodes easily.	Slope, erodes easily, droughty.
OeB*, OeC*:						
Opal	Moderate: depth to rock, slope.	Slight	Deep to water	Slope, droughty, slow intake.	Depth to rock, erodes easily.	Erodes easily, droughty.
Promise	Moderate: slope.	Severe: hard to pack.	Deep to water	Slope, droughty, slow intake.	Erodes easily, percs slowly.	Erodes easily, droughty.
Of* Orthents, clayey	Severe: depth to rock, slope.	Severe: hard to pack.	Deep to water	Slope, depth to rock.	Slope, depth to rock.	Slope, depth to rock.
Og* Orthents, gravelly	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty.	Slope, too sandy.	Slope, droughty, rooting depth.
OtA Ottumwa	Moderate: depth to rock.	Severe: hard to pack.	Deep to water	Droughty, slow intake.	Erodes easily, percs slowly.	Erodes easily, droughty.
OtB Ottumwa	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Slope, droughty, slow intake.	Erodes easily, percs slowly.	Erodes easily, droughty.
OvA*:						
Ottumwa	Moderate: depth to rock.	Severe: hard to pack.	Deep to water	Droughty, slow intake.	Erodes easily, percs slowly.	Erodes easily, droughty.
Capa	Slight	Severe: hard to pack, excess sodium.	Deep to water	Droughty, percs slowly.	Erodes easily, percs slowly.	Excess sodium, erodes easily, droughty.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
OwB*, OwC*:						
Ottumwa	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Slope, droughty, slow intake.	Erodes easily, percs slowly.	Erodes easily, droughty.
Lakoma	Moderate: seepage, slope.	Severe: hard to pack.	Deep to water	Slope, droughty, slow intake.	Area reclaim, erodes easily.	Erodes easily, droughty.
OxC*:						
Ottumwa	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Slope, droughty, slow intake.	Erodes easily, percs slowly.	Erodes easily, droughty.
Razor	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Slope, slow intake, percs slowly.	Depth to rock, erodes easily.	Too arid, erodes easily.
OyC*:						
Ottumwa	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Slope, droughty, slow intake.	Erodes easily, percs slowly.	Erodes easily, droughty.
Razor	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, slow intake, percs slowly.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
Savo	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope	Erodes easily	Too arid, erodes easily.
PeC: Pierre	Moderate: depth to rock, slope.	Slight	Deep to water	Slope, droughty, slow intake.	Depth to rock, erodes easily.	Too arid, erodes easily.
PeD: Pierre	Severe: slope.	Slight	Deep to water	Slope, droughty, slow intake.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
PkE*:						
Pierre	Severe: slope.	Slight	Deep to water	Slope, droughty, slow intake.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
Samsil	Severe: seepage, slope.	Severe: hard to pack, thin layer.	Deep to water	Slope, droughty, slow intake.	Slope, area reclaim, erodes easily.	Slope, erodes easily, droughty.
PrA: Promise	Slight	Severe: hard to pack.	Deep to water	Droughty, slow intake.	Erodes easily, percs slowly.	Erodes easily, droughty.
PrB: Promise	Moderate: slope.	Severe: hard to pack.	Deep to water	Slope, droughty, slow intake.	Erodes easily, percs slowly.	Erodes easily, droughty.
RaB, RaC: Razor	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Slope, slow intake, percs slowly.	Depth to rock, erodes easily.	Too arid, erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
RbD*:						
Razor	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, slow intake, percs slowly.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
Midway	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Slope, percs slowly.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
RdD*:						
Razor	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, slow intake, percs slowly.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
Shingle	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Slope, depth to rock.	Slope, depth to rock.	Too arid, slope, depth to rock.
ReA Ree	Severe: seepage.	Severe: thin layer.	Deep to water	Favorable	Favorable	Favorable.
ReB Ree	Severe: seepage.	Severe: thin layer.	Deep to water	Slope	Favorable	Favorable.
RfB*, RfC*:						
Ree	Severe: seepage.	Severe: thin layer.	Deep to water	Slope	Favorable	Favorable.
Canning	Severe: seepage.	Severe: seepage.	Deep to water	Slope, rooting depth.	Too sandy	Rooting depth.
Rh*:						
Ree	Severe: seepage.	Severe: thin layer.	Deep to water	Favorable	Favorable	Favorable.
Hoven	Slight	Severe: hard to pack, ponding, excess sodium.	Ponding, percs slowly, excess salt.	Ponding, percs slowly, erodes easily.	Erodes easily, ponding, percs slowly.	Wetness, excess sodium, erodes easily.
RkD*:						
Ree	Severe: seepage.	Severe: thin layer.	Deep to water	Slope	Favorable	Favorable.
Vivian	Severe: seepage, slope.	Moderate: thin layer.	Deep to water	Slope, droughty.	Slope	Slope, droughty.
Rv* Riverwash	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave.	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty, rooting depth.
SbF Samsil	Severe: seepage, slope.	Severe: hard to pack, thin layer.	Deep to water	Slope, droughty, slow intake.	Slope, area reclaim, erodes easily.	Slope, erodes easily, droughty.
ScF*:						
Samsil	Severe: seepage, slope.	Severe: hard to pack, thin layer.	Deep to water	Slope, droughty, slow intake.	Slope, area reclaim, erodes easily.	Slope, erodes easily, droughty.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
ScF*:						
Nihill	Severe: seepage, slope.	Moderate: thin layer.	Deep to water	Slope, droughty.	Slope	Too arid, slope, droughty.
SdF*:						
Samsil	Severe: seepage, slope.	Severe: hard to pack, thin layer.	Deep to water	Slope, droughty, slow intake.	Slope, area reclaim, erodes easily.	Slope, erodes easily, droughty.
Rock outcrop	Severe: seepage, depth to rock, slope.	Severe: hard to pack.	Deep to water	Slope, depth to rock, rooting depth.	Slope, depth to rock.	Slope, depth to rock, rooting depth.
SoE*:						
Sansarc	Severe: depth to rock, slope.	Severe: hard to pack.	Deep to water	Slope, droughty, slow intake.	Slope, depth to rock, erodes easily.	Slope, erodes easily, droughty.
Opal	Severe: slope.	Slight	Deep to water	Slope, droughty, slow intake.	Slope, depth to rock, erodes easily.	Slope, erodes easily, droughty.
SrA Savo	Slight	Moderate: hard to pack.	Deep to water	Favorable	Erodes easily	Too arid, erodes easily.
SrB, SrC Savo	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope	Erodes easily	Too arid, erodes easily.
StF*:						
Schamber	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty.	Slope, too sandy.	Too arid, slope, droughty.
Samsil	Severe: seepage, slope.	Severe: hard to pack, thin layer.	Deep to water	Slope, droughty, slow intake.	Slope, area reclaim, erodes easily.	Slope, erodes easily, droughty.
SuE Shingle	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Slope, depth to rock.	Slope, depth to rock.	Too arid, slope, depth to rock.
SwE*:						
Shingle	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Slope, depth to rock.	Slope, depth to rock.	Too arid, slope, depth to rock.
Razor	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, slow intake, percs slowly.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
Wc Wendte	Slight	Severe: hard to pack.	Deep to water	Slow intake, percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Wd*:						
Wendte	Slight	Severe: hard to pack.	Deep to water	Slow intake, percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Wd*:						
Herdcamp----------	Slight----------	Severe: hard to pack, wetness.	Percs slowly, flooding, frost action.	Wetness, droughty, slow intake.	Wetness, percs slowly.	Wetness, droughty.
WsE*:						
Wendte------------	Slight----------	Severe: hard to pack.	Deep to water	Slow intake, percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Sansarc-----------	Severe: depth to rock, slope, seepage.	Severe: hard to pack.	Deep to water	Slope, droughty, slow intake.	Slope, depth to rock, erodes easily.	Slope, erodes easily, droughty.
Ww*:						
Wortman-----------	Moderate: seepage.	Severe: piping, excess sodium.	Deep to water	Percs slowly, thin layer.	Area reclaim---	Excess sodium, area reclaim, percs slowly.
Wanblee-----------	Moderate: depth to rock.	Severe: excess sodium.	Deep to water	Percs slowly---	Depth to rock, erodes easily.	Too arid, excess sodium, erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ab---------------- Albaton	0-60	Silty clay--------	CH, MH	A-7	0	100	100	95-100	95-100	70-90	40-60
Ar---------------- Arvada	0-3	Silt loam---------	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-95	70-80	20-30	5-15
	3-14	Clay, silty clay loam, clay loam.	CL, CH	A-7	0	80-100	75-100	70-100	65-95	40-65	20-35
	14-60	Clay loam, silty clay loam, clay.	CL	A-7	0	80-100	75-100	70-100	55-90	40-50	15-25
As*: Arvada----------	0-3	Silt loam---------	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-95	70-80	20-30	5-15
	3-14	Clay, silty clay loam, clay loam.	CL, CH	A-7	0	80-100	75-100	70-100	65-95	40-65	20-35
	14-60	Clay loam, silty clay loam, clay.	CL	A-7	0	80-100	75-100	70-100	55-90	40-50	15-25
Slickspots-------	0-60	Clay--------------	CH, MH	A-7	0	100	100	90-100	80-100	55-75	25-45
Bc---------------- Bankard	0-6	Loamy sand--------	SM	A-2	0	100	80-100	50-75	20-30	---	NP
	6-60	Stratified gravelly sand to loam.	SM, SP-SM	A-2, A-1, A-3	0-5	65-100	60-85	40-75	5-35	---	NP
Bd---------------- Bankard	0-10	Very fine sandy loam.	ML, CL, CL-ML	A-4	0	100	100	85-95	50-65	20-30	NP-10
	10-60	Sand, fine sand, loamy sand.	SP-SM, SM	A-2, A-3, A-1	0-5	80-100	75-100	40-70	5-35	---	NP
BkA, BkB---------- Blackpipe	0-4	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-100	35-50	15-25
	4-17	Silty clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	95-100	85-100	40-70	15-45
	17-28	Silty clay loam, silt loam, loam.	CL	A-6, A-7	0	95-100	90-100	85-100	75-100	30-50	10-26
	28-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Bo*: Blackpipe--------	0-4	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-100	35-50	15-25
	4-17	Silty clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	95-100	85-100	40-70	15-45
	17-28	Silty clay loam, silt loam, loam.	CL	A-6, A-7	0	95-100	90-100	85-100	75-100	30-50	10-26
	28-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Wortman----------	0-5	Silt loam---------	CL, ML	A-4, A-6	0	100	95-100	85-100	80-95	30-40	5-15
	5-13	Clay, clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-95	40-75	15-45
	13-36	Loam, silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	95-100	85-95	60-80	30-45	5-20
	36-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Bu---------------- Bullcreek	0-3	Clay--------------	MH, CH	A-7	0	95-100	95-100	90-100	85-100	60-100	28-60
	3-16	Clay--------------	MH, CH	A-7	0	95-100	95-100	90-100	85-100	70-100	35-60
	16-26	Clay--------------	MH, CH	A-7	0	95-100	95-100	90-100	85-100	70-100	35-60
	26-60	Clay--------------	CH	A-7	0	95-100	95-100	90-100	85-100	70-100	40-60

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Frag-ments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
Bx*:											
Bullcreek-------	0-3	Clay-------------	MH, CH	A-7	0	95-100	95-100	90-100	85-100	60-100	28-60
	3-16	Clay-------------	MH, CH	A-7	0	95-100	95-100	90-100	85-100	70-100	35-60
	16-26	Clay-------------	MH, CH	A-7	0	95-100	95-100	90-100	85-100	70-100	35-60
	26-60	Clay-------------	CH	A-7	0	95-100	95-100	90-100	85-100	70-100	40-60
Slickspots------	0-60	Clay-------------	CH, MH	A-7	0	100	100	90-100	80-100	55-75	25-45
Ca--------------- Canning	0-6	Loam-------------	CL	A-4, A-6	0	100	100	85-100	50-90	30-40	8-15
	6-27	Clay loam, sandy clay loam.	CL, SC	A-6, A-7	0	95-100	85-100	60-90	35-80	30-45	10-20
	27-60	Gravelly sand, very gravelly sand, very gravelly loamy sand.	SM, SC-SM, GM, GM-GC	A-1, A-2, A-3	0	40-100	30-80	15-70	5-30	15-25	NP-5
CbA-------------- Capa	0-2	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-40	7-20
	2-20	Clay-------------	CH, MH	A-7	0	100	100	95-100	90-100	60-85	25-50
	20-60	Clay, silty clay	CH, MH	A-7	0	100	100	95-100	90-100	60-85	25-50
Cc*:											
Capa------------	0-2	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-40	7-20
	2-20	Clay-------------	CH, MH	A-7	0	100	100	95-100	90-100	60-85	25-50
	20-60	Clay, silty clay	CH, MH	A-7	0	100	100	95-100	90-100	60-85	25-50
Slickspots------	0-60	Clay-------------	CH, MH	A-7	0	100	100	90-100	80-100	55-75	25-45
Ct*:											
Capa------------	0-2	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-40	7-20
	2-20	Clay-------------	CH, MH	A-7	0	100	100	95-100	90-100	60-85	25-50
	20-60	Clay, silty clay	CH, MH	A-7	0	100	100	95-100	90-100	60-85	25-50
Wendte----------	0-6	Silty clay-------	CH, MH	A-7	0	100	100	90-100	80-100	50-80	20-50
	6-60	Stratified silty clay loam to clay.	CH, MH	A-7	0	100	100	90-100	70-100	50-80	20-50
Cv--------------- Craft	0-5	Very fine sandy loam.	ML, CL-ML, SM, SC-SM	A-4	0	95-100	95-100	70-95	45-85	15-20	NP-5
	5-60	Very fine sandy loam, silt loam, loam.	ML, CL-ML	A-4	0	95-100	95-100	85-100	80-100	15-25	NP-5
Eg--------------- Egas	0-6	Silty clay loam	CH, MH	A-7	0	100	100	95-100	90-100	50-90	22-50
	6-60	Silty clay, silty clay loam, clay.	CH, MH	A-7	0	100	100	90-100	85-100	50-90	22-50
Ha--------------- Haverson	0-12	Silt loam--------	ML	A-4	0	95-100	90-100	85-100	55-90	25-35	NP-10
	12-60	Stratified silty clay to sand.	CL, CL-ML, ML	A-4, A-6, A-7	0	95-100	85-100	70-95	50-70	25-40	5-15
Hb--------------- Haverson	0-12	Silt loam--------	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	80-95	20-45	3-20
	12-60	Stratified silty clay to sand.	ML, CL-ML, CL	A-6, A-7, A-4	0	100	95-100	85-95	60-90	23-45	3-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Hc*:											
Haverson--------	0-12	Silt loam--------	ML	A-4	0	95-100	90-100	85-100	55-90	25-35	NP-10
	12-60	Stratified silty clay to sand.	CL, CL-ML, ML	A-4, A-6, A-7	0	95-100	85-100	70-95	50-70	25-40	5-15
Craft-----------	0-5	Very fine sandy loam.	ML, CL-ML, SM, SC-SM	A-4	0	95-100	95-100	70-95	45-85	15-20	NP-5
	5-60	Very fine sandy loam, silt loam, loam.	ML, CL-ML	A-4	0	95-100	95-100	85-100	80-100	15-25	NP-5
Ho--------------- Hilmoe	0-15	Silty clay-------	CL, CH	A-7	0	100	95-100	95-100	80-100	40-60	20-40
	15-37	Stratified silty clay loam to clay.	CL, CH	A-7	0	100	95-100	95-100	80-100	40-65	20-40
	37-60	Stratified very fine sandy loam to clay loam.	CL-ML, CL	A-4, A-6	0	95-100	95-100	90-100	55-80	25-40	5-15
HpB-------------- Hisle	0-2	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-40	5-15
	2-28	Clay, silty clay	CH, CL	A-7	0	95-100	90-100	85-100	80-100	45-85	20-55
	28-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Hv--------------- Hoven	0-3	Silt loam--------	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	75-95	27-45	5-20
	3-7	Silty clay, clay, clay loam.	CH, MH, CL, ML	A-7	0	100	95-100	95-100	80-100	45-80	20-40
	7-23	Silty clay, clay, clay loam.	CH, MH, CL, ML	A-7	0	100	95-100	95-100	80-100	45-80	20-40
	23-60	Silty clay, clay, clay loam.	CL, CH	A-6, A-7	0	95-100	90-100	80-100	60-100	35-75	11-45
KeA, KeB, KeD---- Kirley	0-5	Clay loam--------	CL	A-6, A-7	0	100	95-100	90-100	65-80	25-45	11-20
	5-21	Clay, clay loam	CL, CH	A-6, A-7	0	100	95-100	90-100	65-80	35-60	15-35
	21-34	Clay loam, clay	CL, CH, MH, ML	A-6, A-7	0	100	90-100	85-100	55-85	35-55	10-30
	34-60	Loam, clay loam	CL, ML	A-6, A-7, A-4	0	100	90-100	85-100	50-75	30-45	8-15
KfB*:											
Kirley----------	0-5	Clay loam--------	CL	A-6, A-7	0	100	95-100	90-100	65-80	25-45	11-20
	5-21	Clay, clay loam	CL, CH	A-6, A-7	0	100	95-100	90-100	65-80	35-60	15-35
	21-34	Clay loam, clay	CL, CH, MH, ML	A-6, A-7	0	100	90-100	85-100	55-85	35-55	10-30
	34-60	Loam, clay loam	CL, ML	A-6, A-7, A-4	0	100	90-100	85-100	50-75	30-45	8-15
Canning---------	0-6	Loam-------------	CL	A-4, A-6	0	100	100	85-100	50-90	30-40	8-15
	6-27	Clay loam, sandy clay loam.	CL, SC	A-6, A-7	0	95-100	85-100	60-90	35-80	30-45	10-20
	27-60	Gravelly sand, very gravelly sand, very gravelly loamy sand.	SM, SC-SM, GM, GM-GC	A-1, A-2, A-3	0	40-100	30-80	15-70	5-30	15-25	NP-5

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
KhA*, KhB*:											
Kirley----------	0-5	Clay loam--------	CL	A-6, A-7	0	100	95-100	90-100	65-80	25-45	11-20
	5-21	Clay, clay loam	CL, CH	A-6, A-7	0	100	95-100	90-100	65-80	35-60	15-35
	21-34	Clay loam, clay	CL, CH, MH, ML	A-6, A-7	0	100	90-100	85-100	55-85	35-55	10-30
	34-60	Loam, clay loam	CL, ML	A-6, A-7, A-4	0	100	90-100	85-100	50-75	30-45	8-15
Mosher----------	0-6	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	85-100	70-100	25-40	5-20
	6-18	Clay loam, silty clay, clay.	CL, ML, CH, MH	A-7	0	100	95-100	90-100	70-100	40-65	15-30
	18-60	Clay loam, silty clay, loam.	CL, CH, ML, MH	A-6, A-7	0	100	95-100	90-100	70-100	35-60	10-35
KmA*, KmB*, KmC*:											
Kirley----------	0-5	Clay loam--------	CL	A-6, A-7	0	100	95-100	90-100	65-80	25-45	11-20
	5-21	Clay, clay loam	CL, CH	A-6, A-7	0	100	95-100	90-100	65-80	35-60	15-35
	21-34	Clay loam, clay	CL, CH, MH, ML	A-6, A-7	0	100	90-100	85-100	55-85	35-55	10-30
	34-60	Loam, clay loam	CL, ML	A-6, A-7, A-4	0	100	90-100	85-100	50-75	30-45	8-15
Ottumwa---------	0-6	Silty clay-------	CH, MH	A-7	0	100	100	95-100	85-100	55-80	25-50
	6-26	Silty clay, clay	CH, MH	A-7	0	100	100	95-100	85-100	55-80	25-50
	26-60	Silty clay, clay	CH, MH	A-7	0	100	95-100	90-100	85-100	50-80	20-50
KnD*:											
Kirley----------	0-5	Clay loam--------	CL	A-6, A-7	0	100	95-100	90-100	65-80	25-45	11-20
	5-21	Clay, clay loam	CL, CH	A-6, A-7	0	100	95-100	90-100	65-80	35-60	15-35
	21-34	Clay loam, clay	CL, CH, MH, ML	A-6, A-7	0	100	90-100	85-100	55-85	35-55	10-30
	34-60	Loam, clay loam	CL, ML	A-6, A-7, A-4	0	100	90-100	85-100	50-75	30-45	8-15
Vivian----------	0-10	Gravelly loam----	CL, SC	A-4, A-6	0-5	80-100	50-75	45-60	35-55	30-40	8-18
	10-50	Very gravelly loam, extremely gravelly loam, very gravelly fine sandy loam.	GC, GP-GC	A-2, A-4, A-6	0-5	40-60	20-50	15-50	10-50	30-40	8-18
	50-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Ko--------------- Kolls	0-26	Clay-------------	CH, MH	A-7	0	100	100	95-100	85-100	50-90	25-50
	26-32	Clay-------------	CH, MH	A-7	0	100	100	95-100	85-100	60-90	25-55
	32-60	Clay-------------	CH, MH	A-7	0	100	100	95-100	85-100	60-90	25-55
KyA, KyB--------- Kyle	0-4	Clay-------------	CH, MH	A-7	0	100	100	90-100	80-100	55-75	25-45
	4-27	Clay-------------	CH, MH	A-7	0	100	100	90-100	80-100	55-75	25-45
	27-60	Clay-------------	CH, MH	A-7	0	100	100	90-100	80-100	60-90	25-55
LaB, LaC, LaD---- Lakoma	0-5	Silty clay-------	CH, MH	A-7	0	100	95-100	90-100	85-100	55-85	25-50
	5-21	Silty clay, clay	CH, MH	A-7	0	95-100	85-100	85-100	85-100	55-85	25-50
	21-28	Silty clay, clay	CH, MH	A-7	0	95-100	70-100	60-100	50-100	55-85	25-50
	28-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
LbE*:											
Lakoma----------	0-5	Silty clay-------	CH, MH	A-7	0	100	95-100	90-100	85-100	55-85	25-50
	5-21	Silty clay, clay	CH, MH	A-7	0	95-100	85-100	85-100	85-100	55-85	25-50
	21-28	Silty clay, clay,	CH, MH	A-7	0	95-100	70-100	60-100	50-100	55-85	25-50
	28-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
LbE*:											
Vivian	0-10	Gravelly loam	CL, SC	A-4, A-6	0-5	80-100	50-75	45-60	35-55	30-40	8-18
	10-50	Very gravelly loam, extremely gravelly loam, very gravelly fine sandy loam.	GC, GP-GC	A-2, A-4, A-6	0-5	40-60	20-50	15-50	10-50	30-40	8-18
	50-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Lo, Lp: Lohmiller	0-4	Silty clay	CL, CH	A-7	0	100	100	95-100	85-100	45-60	20-30
	4-60	Silty clay loam, clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-100	40-60	15-30
Lv*:											
Lohmiller	0-4	Silty clay	CL, CH	A-7	0	100	100	95-100	85-100	45-60	20-30
	4-60	Silty clay loam, clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-100	40-60	15-30
Arvada	0-3	Silt loam	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-95	70-80	20-30	5-15
	3-14	Clay, silty clay loam, clay loam.	CL, CH	A-7	0	80-100	75-100	70-100	65-95	40-65	20-35
	14-60	Clay loam, silty clay loam, clay.	CL	A-7	0	80-100	75-100	70-100	55-90	40-50	15-25
MaE: Midway	0-4	Silty clay loam	CL	A-6	0	75-100	75-100	70-100	70-95	30-40	10-20
	4-13	Clay, clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	95-100	90-100	70-95	30-50	15-25
	13-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Mo: Mosher	0-6	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	85-100	70-100	25-40	5-20
	6-18	Clay loam, silty clay, clay.	CL, ML, CH, MH	A-7	0	100	95-100	90-100	70-100	40-65	15-30
	18-60	Clay loam, silty clay, loam.	CL, CH, ML, MH	A-6, A-7	0	100	95-100	90-100	70-100	35-60	10-35
Nb: Nimbro	0-8	Silty clay loam	ML, CL	A-6, A-7	0	100	100	95-100	85-100	30-50	11-20
	8-60	Stratified loam to silty clay loam.	CL	A-6, A-7	0	90-100	90-100	80-100	70-95	30-45	11-20
Nc: Nimbro	0-8	Silty clay loam	ML, CL	A-6, A-7	0	100	100	95-100	85-100	30-50	11-20
	8-60	Stratified loam to silty clay loam.	CL	A-6, A-7	0	90-100	90-100	80-100	70-95	30-45	11-20
NuA, NuB, NuC: Nunn	0-5	Loam	CL, SC	A-6	0-5	95-100	80-95	70-95	45-75	30-40	10-20
	5-37	Clay loam, clay	CL, CH	A-6, A-7	0-5	95-100	90-100	85-95	65-75	35-60	20-35
	37-60	Clay loam, loam, gravelly sandy loam.	CL, SC, ML, SM	A-4, A-6, A-7	0-5	80-100	80-100	60-90	35-75	30-45	5-20
NxD*:											
Nunn	0-5	Loam	CL, SC	A-6	0-5	95-100	80-95	70-95	45-75	30-40	10-20
	5-37	Clay loam, clay	CL, CH	A-6, A-7	0-5	95-100	90-100	85-95	65-75	35-60	20-35
	37-60	Clay loam, loam, gravelly sandy loam.	CL, SC, ML, SM	A-4, A-6, A-7	0-5	80-100	80-100	60-90	35-75	30-45	5-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
NxD*:											
Nihill----------	0-9	Gravelly loam----	GM, SM, ML	A-2, A-4	0-5	60-85	50-75	35-65	30-60	0-35	NP-10
	9-60	Very gravelly loam, very gravelly sandy loam, very gravelly clay loam.	GM-GC, GC, GP-GC	A-2, A-1	0-15	30-60	25-50	15-40	10-35	25-40	5-15
ObE*:											
Okaton----------	0-4	Silty clay-------	CH, MH	A-7	0	100	95-100	90-100	85-100	50-85	20-50
	4-14	Clay, silty clay	CH, MH	A-7	0	100	95-100	90-100	85-100	50-85	20-50
	14-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Lakoma----------	0-5	Silty clay-------	CH, MH	A-7	0	100	95-100	90-100	85-100	55-85	25-50
	5-21	Silty clay, clay	CH, MH	A-7	0	95-100	85-100	85-100	85-100	55-85	25-50
	21-28	Silty clay, clay	CH, MH	A-7	0	95-100	70-100	60-100	50-100	55-85	25-50
	28-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Oc--------------- Onita	0-12	Silt loam--------	CL, ML	A-4, A-6, A-7	0	100	95-100	90-100	70-100	30-45	7-20
	12-37	Silty clay loam, clay loam, silty clay.	CL, CH, ML, MH	A-7	0	100	95-100	90-100	75-100	40-60	10-30
	37-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-6, A-7	0-5	95-100	95-100	85-100	65-100	30-55	10-30
OdB, OdC, OdD---- Opal	0-6	Clay-------------	CH, MH	A-7	0-2	100	100	90-100	80-100	60-80	25-45
	6-33	Clay-------------	CH, MH	A-7	0-2	100	100	90-100	80-100	65-85	30-50
	33-36	Clay-------------	CH, MH	A-7	0-2	100	95-100	90-100	80-100	65-85	30-50
	36-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
OeB*, OeC*:											
Opal------------	0-6	Clay-------------	CH, MH	A-7	0-2	100	100	90-100	80-100	60-80	25-45
	6-33	Clay-------------	CH, MH	A-7	0-2	100	100	90-100	80-100	65-85	30-50
	33-36	Clay-------------	CH, MH	A-7	0-2	100	95-100	90-100	80-100	65-85	30-50
	36-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Promise---------	0-5	Clay-------------	CH, MH	A-7	0	100	100	90-100	80-100	55-90	25-55
	5-29	Clay-------------	CH, MH	A-7	0	100	100	90-100	85-100	60-85	25-50
	29-60	Clay, silty clay	CH, MH	A-7	0	100	100	90-100	85-100	60-90	25-55
Of*-------------- Orthents, clayey	0-4	Gravelly clay loam.	CL, SC	A-4, A-6	0-5	80-100	50-75	45-60	35-55	30-40	8-18
	4-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Og*-------------- Orthents, gravelly	0-4	Gravelly loam----	SM, GM	A-4, A-2	0-5	60-90	50-80	45-70	25-50	20-35	NP-7
	4-60	Gravelly loamy sand, gravelly sand, very gravelly sand.	SW, SW-SM, SM	A-1	0-10	60-85	45-70	15-45	0-15	15-25	NP-5
OtA, OtB--------- Ottumwa	0-6	Silty clay-------	CH, MH	A-7	0	100	100	95-100	85-100	55-80	25-50
	6-26	Silty clay, clay	CH, MH	A-7	0	100	100	95-100	85-100	55-80	25-50
	26-60	Silty clay, clay	CH, MH	A-7	0	100	95-100	90-100	85-100	50-80	20-50

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
OvA*:											
Ottumwa---------	0-6	Silty clay-------	CH, MH	A-7	0	100	100	95-100	85-100	55-80	25-50
	6-26	Silty clay, clay	CH, MH	A-7	0	100	100	95-100	85-100	55-80	25-50
	26-60	Silty clay, clay	CH, MH	A-7	0	100	95-100	90-100	85-100	50-80	20-50
Capa------------	0-2	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-40	7-20
	2-20	Clay-------------	CH, MH	A-7	0	100	100	95-100	90-100	60-85	25-50
	20-60	Clay, silty clay	CH, MH	A-7	0	100	100	95-100	90-100	60-85	25-50
OwB*, OwC*:											
Ottumwa---------	0-6	Silty clay-------	CH, MH	A-7	0	100	100	95-100	85-100	55-80	25-50
	6-26	Silty clay, clay	CH, MH	A-7	0	100	100	95-100	85-100	55-80	25-50
	26-60	Silty clay, clay	CH, MH	A-7	0	100	95-100	90-100	85-100	50-80	20-50
Lakoma----------	0-5	Silty clay-------	CH, MH	A-7	0	100	95-100	90-100	85-100	55-85	25-50
	5-21	Silty clay, clay	CH, MH	A-7	0	95-100	85-100	85-100	85-100	55-85	25-50
	21-28	Silty clay, clay	CH, MH	A-7	0	95-100	70-100	60-100	50-100	55-85	25-50
	28-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
OxC*:											
Ottumwa---------	0-6	Silty clay-------	CH, MH	A-7	0	100	100	95-100	85-100	55-80	25-50
	6-26	Silty clay, clay	CH, MH	A-7	0	100	100	95-100	85-100	55-80	25-50
	26-60	Silty clay, clay	CH, MH	A-7	0	100	95-100	90-100	85-100	50-80	20-50
Razor-----------	0-4	Silty clay-------	CL, CH	A-7	0-5	95-100	95-100	90-100	80-100	40-60	20-35
	4-14	Silty clay, silty clay loam, clay.	CL, CH	A-6, A-7	0	100	95-100	90-100	80-100	35-60	20-45
	14-29	Silty clay, silty clay loam, clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-100	75-100	35-60	20-45
	29-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
OyC*:											
Ottumwa---------	0-6	Silty clay-------	CH, MH	A-7	0	100	100	95-100	85-100	55-80	25-50
	6-26	Silty clay, clay	CH, MH	A-7	0	100	100	95-100	85-100	55-80	25-50
	26-60	Silty clay, clay	CH, MH	A-7	0	100	95-100	90-100	85-100	50-80	20-50
Razor-----------	0-4	Silty clay-------	CL, CH	A-7	0-5	95-100	95-100	90-100	80-100	40-60	20-35
	4-14	Silty clay, silty clay loam, clay.	CL, CH	A-6, A-7	0	100	95-100	90-100	80-100	35-60	20-45
	14-29	Silty clay, silty clay loam, clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-100	75-100	35-60	20-45
	29-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Savo------------	0-6	Silt loam--------	ML, CL	A-4, A-6, A-7	0	100	100	90-100	70-90	30-45	5-20
	6-20	Silty clay loam, silty clay, clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-65	15-35
	20-35	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	95-100	90-100	85-95	40-55	15-30
	35-60	Silty clay loam, silt loam, clay loam.	CL, CH	A-6, A-7	0	100	95-100	85-100	60-100	35-55	12-30
PeC, PeD--------- Pierre	0-7	Clay-------------	CH, MH	A-7	0	100	100	90-100	80-100	50-90	25-50
	7-27	Clay-------------	CH, MH	A-7	0	100	100	90-100	60-80	60-85	25-50
	27-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
PkE*:											
Pierre----------	0-7	Clay-------------	CH, MH	A-7	0	100	100	90-100	80-100	50-90	25-50
	7-27	Clay-------------	CH, MH	A-7	0	100	100	90-100	60-80	60-85	25-50
	27-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Samsil----------	0-4	Clay-------------	CH, MH	A-7	0	100	85-100	80-100	70-100	50-85	20-50
	4-14	Clay-------------	CH, MH	A-7	0	100	95-100	90-100	85-100	50-90	18-55
	14-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
PrA, PrB--------- Promise	0-5	Clay-------------	CH, MH	A-7	0	100	100	90-100	80-100	55-90	25-55
	5-29	Clay-------------	CH, MH	A-7	0	100	100	90-100	85-100	60-85	25-50
	29-60	Clay, silty clay	CH, MH	A-7	0	100	100	90-100	85-100	60-90	25-55
RaB, RaC--------- Razor	0-4	Silty clay-------	CL, CH	A-7	0-5	95-100	95-100	90-100	80-100	40-60	20-35
	4-14	Silty clay, silty clay loam, clay.	CL, CH	A-6, A-7	0	100	95-100	90-100	80-100	35-60	20-45
	14-29	Silty clay, silty clay loam, clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-100	75-100	35-60	20-45
	29-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
RbD*:											
Razor-----------	0-4	Silty clay-------	CL, CH	A-7	0-5	95-100	95-100	90-100	80-100	40-60	20-35
	4-14	Silty clay, silty clay loam, clay.	CL, CH	A-6, A-7	0	100	95-100	90-100	80-100	35-60	20-45
	14-29	Silty clay, silty clay loam, clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-100	75-100	35-60	20-45
	29-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Midway----------	0-4	Silty clay loam	CL	A-6	0	75-100	75-100	70-100	70-95	30-40	10-20
	4-13	Clay, clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	95-100	90-100	70-95	30-50	15-25
	13-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
RdD*:											
Razor-----------	0-4	Silty clay-------	CL, CH	A-7	0-5	95-100	95-100	90-100	80-100	40-60	20-35
	4-14	Silty clay, silty clay loam, clay.	CL, CH	A-6, A-7	0	100	95-100	90-100	80-100	35-60	20-45
	14-29	Silty clay, silty clay loam, clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-100	75-100	35-60	20-45
	29-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Shingle---------	0-4	Silty clay loam	CL	A-6	0-5	75-100	75-100	65-100	60-85	35-40	15-20
	4-17	Clay loam, loam, silty clay loam.	CL	A-6	0	75-100	75-100	65-100	50-85	30-40	15-20
	17-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
ReA, ReB--------- Ree	0-8	Loam-------------	CL, ML, CL-ML	A-4, A-6, A-7	0	95-100	90-100	80-100	70-95	24-45	3-20
	8-21	Clay loam, sandy clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	90-100	70-100	65-85	30-45	10-20
	21-45	Stratified sandy loam to clay loam.	CL, CL-ML, SC-SM, SC	A-4, A-6, A-7	0	95-100	85-100	70-100	35-85	25-45	5-15
	45-60	Loamy fine sand, fine sand, loamy sand.	SM, SC-SM	A-2	0	95-100	90-100	70-95	15-35	0-20	NP-5

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
RfB*, RfC*:											
Ree	0-8	Loam	CL, ML, CL-ML	A-4, A-6, A-7	0	95-100	90-100	80-100	70-95	24-45	3-20
	8-21	Clay loam, sandy clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	90-100	70-100	65-85	30-45	10-20
	21-45	Stratified sandy loam to clay loam.	CL, CL-ML, SC-SM, SC	A-4, A-6, A-7	0	95-100	85-100	70-100	35-85	25-45	5-15
	45-60	Loamy fine sand, fine sand, loamy sand.	SM, SC-SM	A-2	0	95-100	90-100	70-95	15-35	0-20	NP-5
Canning	0-6	Loam	CL	A-4, A-6	0	100	100	85-100	50-90	30-40	8-15
	6-27	Clay loam, sandy clay loam.	CL, SC	A-6, A-7	0	95-100	85-100	60-90	35-80	30-45	10-20
	27-60	Gravelly sand, very gravelly sand, very gravelly loamy sand.	SM, SC-SM, GM, GM-GC	A-1, A-2, A-3	0	40-100	30-80	15-70	5-30	15-25	NP-5
Rh*:											
Ree	0-8	Loam	CL, ML, CL-ML	A-4, A-6, A-7	0	95-100	90-100	80-100	70-95	24-45	3-20
	8-21	Clay loam, sandy clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	90-100	70-100	65-85	30-45	10-20
	21-45	Stratified fine sandy loam to clay loam.	CL, CL-ML, SC-SM, SC	A-4, A-6, A-7	0	95-100	85-100	70-100	35-85	25-45	5-15
	45-60	Loamy fine sand, fine sand, loamy sand.	SM, SC-SM	A-2	0	95-100	90-100	70-95	15-35	0-20	NP-5
Hoven	0-3	Silt loam	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	75-95	27-45	5-20
	3-7	Silty clay, clay, clay loam.	CH, MH, CL, ML	A-7	0	100	95-100	95-100	80-100	45-80	20-40
	7-23	Silty clay, clay, clay loam.	CH, MH, CL, ML	A-7	0	100	95-100	95-100	80-100	45-80	20-40
	23-60	Silty clay, clay, clay loam.	CL, CH	A-6, A-7	0	95-100	90-100	80-100	60-100	35-75	11-45
RkD*:											
Ree	0-8	Loam	CL, ML, CL-ML	A-4, A-6, A-7	0	95-100	90-100	80-100	70-95	24-45	3-20
	8-21	Clay loam, sandy clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	90-100	70-100	65-85	30-45	10-20
	21-45	Stratified sandy loam to clay loam.	CL, CL-ML, SC-SM, SC	A-4, A-6, A-7	0	95-100	85-100	70-100	35-85	25-45	5-15
	45-60	Loamy fine sand, fine sand, loamy sand.	SM, SC-SM	A-2	0	95-100	90-100	70-95	15-35	0-20	NP-5

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
RkD*:											
Vivian----------	0-10	Gravelly loam----	CL, SC	A-4, A-6	0-5	80-100	50-75	45-60	35-55	30-40	8-18
	10-50	Very gravelly loam, extremely gravelly loam, very gravelly fine sandy loam.	GC, GP-GC	A-2, A-4, A-6	0-5	40-60	20-50	15-50	10-50	30-40	8-18
	50-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rv*------------- Riverwash	0-4	Sand-------------	SP, SP-SM, SM	A-2, A-3	0-5	90-100	85-100	50-70	0-15	---	NP
	4-60	Stratified coarse sand to very fine sand.	SP, SP-SM, SM	A-2, A-3	0-5	90-100	85-100	50-70	0-15	---	NP
SbF------------- Samsil	0-4	Clay-------------	CH, MH	A-7	0	100	85-100	80-100	70-100	50-85	20-50
	4-14	Clay-------------	CH, MH	A-7	0	100	95-100	90-100	85-100	50-90	18-55
	14-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
ScF*:											
Samsil----------	0-4	Clay-------------	CH, MH	A-7	0	100	85-100	80-100	70-100	50-85	20-50
	4-14	Clay-------------	CH, MH	A-7	0	100	95-100	90-100	85-100	50-90	18-55
	14-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Nihill----------	0-9	Gravelly loam----	GM, SM, ML	A-2, A-4	0-5	60-85	50-75	35-65	30-60	0-35	NP-10
	9-60	Very gravelly loam, very gravelly sandy loam, very gravelly clay loam.	GM-GC, GC, GP-GC	A-2, A-1	0-15	30-60	25-50	15-40	10-35	25-40	5-15
SdF*:											
Samsil----------	0-4	Clay-------------	CH, MH	A-7	0	100	85-100	80-100	70-100	50-85	20-50
	4-14	Clay-------------	CH, MH	A-7	0	100	95-100	90-100	85-100	50-90	18-55
	14-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rock outcrop----	0-60	Weathered bedrock	CH, MH	A-7-5	0-15	95-100	95-100	90-100	85-100	50-90	20-55
SoE*:											
Sansarc---------	0-4	Clay-------------	CH, MH	A-7	0	100	95-100	90-100	75-100	60-90	25-55
	4-15	Clay-------------	CH, MH	A-7	0	95-100	95-100	95-100	85-100	60-90	25-55
	15-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Opal------------	0-6	Clay-------------	CH, MH	A-7	0-2	100	100	90-100	80-100	60-80	25-45
	6-33	Clay-------------	CH, MH	A-7	0-2	100	100	90-100	80-100	65-85	30-50
	33-36	Clay-------------	CH, MH	A-7	0-2	100	95-100	90-100	80-100	65-85	30-50
	36-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
SrA, SrB, SrC---- Savo	0-6	Silt loam--------	ML, CL	A-4, A-6, A-7	0	100	100	90-100	70-90	30-45	5-20
	6-20	Silty clay loam, silty clay, clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-65	15-35
	20-35	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	95-100	90-100	85-95	40-55	15-30
	35-60	Silty clay loam, silt loam, clay loam.	CL, CH	A-6, A-7	0	100	95-100	85-100	60-100	35-55	12-30

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
StF*:											
Schamber--------	0-6	Gravelly loam----	SM, SW-SM, GM, GW-GM	A-2, A-1	0-5	55-90	50-75	40-60	10-35	0-25	NP-5
	6-60	Very gravelly sand, very gravelly loamy sand.	SW, SW-SM, GW, GW-GM	A-1	0-15	30-80	25-50	5-20	0-10	0-25	NP-5
Samsil----------	0-4	Clay-------------	CH, MH	A-7	0	100	85-100	80-100	70-100	50-85	20-50
	4-14	Clay-------------	CH, MH	A-7	0	100	95-100	90-100	85-100	50-90	18-55
	14-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
SuE-------------- Shingle	0-4	Silty clay loam	CL	A-6	0-5	75-100	75-100	65-100	60-85	35-40	15-20
	4-17	Clay loam, loam, silty clay loam.	CL	A-6	0	75-100	75-100	65-100	50-85	30-40	15-20
	17-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
SwE*:											
Shingle---------	0-4	Silty clay loam	CL	A-6	0-5	75-100	75-100	65-100	60-85	35-40	15-20
	4-17	Clay loam, loam, silty clay loam.	CL	A-6	0	75-100	75-100	65-100	50-85	30-40	15-20
	17-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Razor-----------	0-4	Silty clay-------	CL, CH	A-7	0-5	95-100	95-100	90-100	80-100	40-60	20-35
	4-14	Silty clay, silty clay loam, clay.	CL, CH	A-6, A-7	0	100	95-100	90-100	80-100	35-60	20-45
	14-29	Silty clay, silty clay loam, clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-100	75-100	35-60	20-45
	29-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Wc--------------- Wendte	0-6	Silty clay-------	CH, MH	A-7	0	100	100	90-100	85-100	50-80	20-50
	6-60	Stratified silty clay loam to clay.	CH, MH	A-7	0	100	100	90-100	70-100	50-80	20-50
Wd*:											
Wendte----------	0-6	Silty clay-------	CH, MH	A-7	0	100	100	90-100	80-100	50-80	20-50
	6-60	Stratified silty clay loam to clay.	CH, MH	A-7	0	100	100	90-100	70-100	50-80	20-50
Herdcamp--------	0-5	Silty clay-------	CH, MH	A-7	0	100	100	90-100	80-100	50-80	20-50
	5-60	Silty clay, clay, silty clay loam.	CH, MH	A-7	0	100	100	90-100	75-100	50-80	20-50
WsE*:											
Wendte----------	0-6	Silty clay-------	CH, MH	A-7	0	100	100	90-100	80-100	50-80	20-50
	6-60	Stratified silty clay loam to clay.	CH, MH	A-7	0	100	100	90-100	70-100	50-80	20-50
Sansarc---------	0-4	Clay-------------	CH, MH	A-7	0	100	95-100	90-100	75-100	60-90	25-55
	4-15	Clay-------------	CH, MH	A-7	0	95-100	95-100	95-100	85-100	60-90	25-55
	15-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ww*:											
Wortman---------	0-5	Silt loam--------	CL, ML	A-4, A-6	0	100	95-100	85-100	80-95	30-40	5-15
	5-13	Clay, clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-95	40-75	15-45
	13-36	Loam, silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	95-100	85-95	60-80	30-45	5-20
	36-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Wanblee---------	0-2	Silt loam--------	CL, ML	A-4, A-6	0	100	100	95-100	80-95	25-40	3-15
	2-9	Clay loam, clay	CL, CH	A-7	0	100	100	90-100	70-85	40-70	15-45
	9-27	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	100	95-100	90-100	65-85	35-50	15-30
	27-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ab---------------- Albaton	0-60	45-60	1.10-1.25	0.01-0.2	0.10-0.14	7.4-8.4	0-0	Very high	0.37	5	4	2-4
Ar---------------- Arvada	0-3	15-27	1.10-1.25	0.6-2.0	0.16-0.18	6.6-9.0	0-4	Low--------	0.43	2	6	.5-1
	3-14	35-60	1.20-1.40	0.01-0.06	0.07-0.09	7.9-9.6	0-2	High-------	0.37			
	14-60	28-45	1.20-1.40	0.06-0.2	0.09-0.11	7.9-9.6	0-4	High-------	0.37			
As*:												
Arvada-----------	0-3	15-27	1.10-1.25	0.6-2.0	0.16-0.18	6.6-9.0	0-4	Low--------	0.43	2	6	.5-1
	3-14	35-60	1.20-1.40	0.01-0.06	0.07-0.09	7.9-9.6	0-2	High-------	0.37			
	14-60	28-45	1.20-1.40	0.06-0.2	0.09-0.11	7.9-9.6	0-4	High-------	0.37			
Slickspots-------	0-60	50-65	1.15-1.30	0.01-0.06	0.08-0.12	8.5-9.0	>16	Very high	0.37	2	4	0-1
Bc---------------- Bankard	0-6	2-10	1.55-1.65	6.0-20	0.06-0.09	7.4-8.4	0-0	Low--------	0.17	5	2	1-2
	6-60	2-10	1.55-1.65	6.0-20	0.05-0.08	7.4-8.4	0-0	Low--------	0.20			
Bd---------------- Bankard	0-10	10-20	1.35-1.45	0.6-2.0	0.17-0.18	7.4-8.4	0-0	Low--------	0.32	4	3	.5-2
	10-60	2-10	1.70-1.80	6.0-20	0.06-0.08	7.4-8.4	0-0	Low--------	0.15			
BkA, BkB---------- Blackpipe	0-4	27-33	1.15-1.30	0.2-0.6	0.19-0.22	6.1-7.8	0-2	Moderate	0.32	3	7	2-4
	4-17	35-50	1.25-1.40	0.2-0.6	0.11-0.19	6.6-7.8	0-2	High-------	0.32			
	17-28	20-34	1.30-1.45	0.2-0.6	0.13-0.20	7.4-8.4	0-2	Moderate	0.32			
	28-60	---	---	0.06-0.6	---	---	---	-----------	----			
Bo*:												
Blackpipe--------	0-4	27-33	1.15-1.30	0.2-0.6	0.19-0.22	6.1-7.8	0-2	Moderate	0.32	3	7	2-4
	4-17	35-50	1.25-1.40	0.2-0.6	0.11-0.19	6.6-7.8	0-2	High-------	0.32			
	17-28	20-34	1.30-1.45	0.2-0.6	0.13-0.20	7.4-8.4	0-2	Moderate	0.32			
	28-60	---	---	0.06-0.6	---	---	---	-----------	----			
Wortman----------	0-5	10-20	1.15-1.30	0.6-2.0	0.20-0.22	6.1-7.8	0-2	Low--------	0.37	2	5	2-4
	5-13	35-50	1.05-1.15	0.01-0.06	0.08-0.14	6.6-8.4	4-16	High-------	0.28			
	13-36	15-26	1.20-1.30	0.2-0.6	0.13-0.15	7.4-9.0	2-16	Moderate	0.37			
	36-60	---	---	0.06-0.6	---	---	---	-----------	----			
Bu---------------- Bullcreek	0-3	55-65	1.10-1.20	0.01-0.06	0.10-0.14	6.6-8.4	0-2	Very high	0.37	5	4	2-4
	3-16	60-70	1.10-1.25	0.01-0.06	0.10-0.14	7.4-9.0	0-4	Very high	0.37			
	16-26	60-70	1.15-1.30	0.01-0.06	0.08-0.12	7.4-9.0	4-16	Very high	0.37			
	26-60	60-70	1.25-1.40	0.01-0.06	0.08-0.12	7.4-9.0	4-16	Very high	0.37			
Bx*:												
Bullcreek--------	0-3	55-65	1.10-1.20	0.01-0.06	0.10-0.14	6.6-8.4	0-2	Very high	0.37	5	4	2-4
	3-16	60-70	1.10-1.25	0.01-0.06	0.10-0.14	7.4-9.0	0-4	Very high	0.37			
	16-26	60-70	1.15-1.30	0.01-0.06	0.08-0.12	7.4-9.0	4-16	Very high	0.37			
	26-60	60-70	1.25-1.40	0.01-0.06	0.08-0.12	7.4-9.0	4-16	Very high	0.37			
Slickspots-------	0-60	50-65	1.15-1.30	0.01-0.06	0.08-0.12	8.5-9.0	>16	Very high	0.37	2	4	0-1
Ca---------------- Canning	0-6	20-26	1.15-1.30	0.6-2.0	0.18-0.20	6.1-7.3	0-2	Low--------	0.28	4	6	2-4
	6-27	27-35	1.25-1.35	0.6-2.0	0.17-0.20	6.6-7.8	0-2	Moderate	0.28			
	27-60	0-5	1.60-1.75	6.0-20	0.03-0.06	7.4-8.4	0-2	Low--------	0.10			
CbA--------------- Capa	0-2	15-25	1.10-1.25	0.6-2.0	0.19-0.22	5.6-7.3	0-2	Low--------	0.37	2	6	1-2
	2-20	60-70	1.25-1.40	0.01-0.06	0.10-0.14	6.6-8.4	4-16	Very high	0.37			
	20-60	45-65	1.25-1.45	0.01-0.06	0.08-0.12	7.9-8.4	4-16	Very high	0.37			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Cc*:												
Capa------------	0-2	15-25	1.10-1.25	0.6-2.0	0.19-0.22	5.6-7.3	0-2	Low--------	0.37	3	6	1-2
	2-20	60-70	1.25-1.40	0.01-0.06	0.10-0.14	6.6-8.4	4-16	Very high	0.37			
	20-60	45-65	1.25-1.45	0.01-0.06	0.08-0.12	7.9-8.4	4-16	Very high	0.37			
Slickspots------	0-60	50-65	1.15-1.30	0.01-0.06	0.08-0.12	8.5-9.0	>16	Very high	0.37	2	4	0-1
Ct*:												
Capa------------	0-2	15-25	1.10-1.25	0.6-2.0	0.19-0.22	5.6-7.3	0-2	Low--------	0.37	2	6	1-2
	2-20	60-70	1.25-1.40	0.01-0.06	0.10-0.14	6.6-8.4	4-16	Very high	0.37			
	20-60	45-65	1.25-1.45	0.01-0.06	0.08-0.12	7.9-8.4	4-16	Very high	0.37			
Wendte----------	0-6	40-60	1.15-1.25	0.06-0.2	0.13-0.18	7.4-8.4	0-2	Very high	0.37	5	4	3-5
	6-60	45-55	1.20-1.40	0.06-0.2	0.11-0.17	7.4-8.4	0-2	Very high	0.37			
Cv--------------- Craft	0-5	5-15	1.30-1.50	2.0-6.0	0.13-0.17	7.4-8.4	0-2	Low--------	0.32	5	3	.5-2
	5-60	8-20	1.20-1.40	2.0-6.0	0.17-0.19	7.4-8.4	0-4	Low--------	0.43			
Eg--------------- Egas	0-6	35-40	1.15-1.30	0.06-0.2	0.10-0.15	7.4-9.0	8-16	High-------	0.37	5	4	2-4
	6-60	35-50	1.25-1.40	0.06-0.2	0.08-0.13	7.9-9.0	8-16	High-------	0.32			
Ha--------------- Haverson	0-12	10-26	1.20-1.35	0.6-2.0	0.14-0.18	6.6-8.4	0-0	Low--------	0.28	5	4L	1-2
	12-60	18-35	1.30-1.45	0.6-2.0	0.14-0.18	7.4-9.0	2-4	Moderate	0.20			
Hb--------------- Haverson	0-12	10-26	1.15-1.30	0.6-2.0	0.19-0.22	6.6-8.4	0-2	Low--------	0.32	5	4L	1-2
	12-60	18-34	1.30-1.45	0.6-2.0	0.15-0.18	6.6-8.4	0-2	Moderate	0.28			
Hc*:												
Haverson--------	0-12	10-26	1.20-1.35	0.6-2.0	0.14-0.18	7.4-8.4	0-0	Low--------	0.32	5	4L	1-2
	12-60	18-35	1.30-1.45	0.6-2.0	0.14-0.18	7.4-9.0	2-4	Moderate	0.20			
Craft-----------	0-5	5-15	1.30-1.50	2.0-6.0	0.13-0.17	7.4-8.4	0-2	Low--------	0.32	5	3	.5-2
	5-60	8-20	1.20-1.40	2.0-6.0	0.17-0.19	7.4-8.4	0-4	Low--------	0.43			
Ho--------------- Hilmoe	0-15	40-50	1.15-1.25	0.06-0.2	0.19-0.22	7.4-8.4	0-2	High-------	0.28	5	4	2-4
	15-37	35-60	1.20-1.35	0.06-0.2	0.17-0.20	7.4-8.4	0-2	High-------	0.37			
	37-60	20-30	1.30-1.45	0.2-2.0	0.16-0.20	7.4-8.4	0-4	Moderate	0.28			
HpB-------------- Hisle	0-2	18-27	1.10-1.25	0.6-2.0	0.18-0.20	6.1-7.8	0-2	Low--------	0.37	3	6	1-3
	2-28	50-60	1.25-1.40	0.01-0.06	0.05-0.12	7.4-9.0	2-16	Very high	0.37			
	28-60	---	---	0.01-0.2	---	---	---	----------	----			
Hv--------------- Hoven	0-3	22-26	1.15-1.25	0.6-2.0	0.19-0.22	5.6-7.3	0-2	Low--------	0.37	2	6	2-4
	3-7	35-60	1.15-1.30	0.01-0.06	0.10-0.19	6.1-7.8	4-16	High-------	0.37			
	7-23	35-60	1.15-1.30	0.01-0.06	0.10-0.19	6.6-8.4	4-16	High-------	0.37			
	23-60	35-60	1.30-1.50	0.01-0.2	0.08-0.17	7.4-9.0	4-16	High-------	0.37			
KeA, KeB, KeD---- Kirley	0-5	27-30	1.25-1.35	0.6-2.0	0.19-0.22	6.1-7.3	0-2	Moderate	0.32	5	6	2-4
	5-21	35-50	1.20-1.35	0.06-0.6	0.11-0.19	6.1-7.8	0-2	High-------	0.32			
	21-34	27-50	1.25-1.40	0.2-2.0	0.11-0.18	7.4-8.4	0-2	High-------	0.37			
	34-60	25-40	1.25-1.40	0.2-2.0	0.14-0.17	7.4-8.4	0-2	Moderate	0.37			
KfB*:												
Kirley----------	0-5	27-30	1.25-1.35	0.6-2.0	0.19-0.22	6.1-7.3	0-2	Moderate	0.32	5	6	2-4
	5-21	35-50	1.20-1.35	0.06-0.6	0.11-0.19	6.1-7.8	0-2	High-------	0.32			
	21-34	27-50	1.25-1.40	0.2-2.0	0.11-0.18	7.4-8.4	0-2	High-------	0.37			
	34-60	25-40	1.25-1.40	0.2-2.0	0.14-0.17	7.4-8.4	0-2	Moderate	0.37			
Canning---------	0-6	20-26	1.15-1.30	0.6-2.0	0.18-0.20	6.1-7.3	0-2	Low--------	0.28	4	6	2-4
	6-27	27-35	1.25-1.35	0.6-2.0	0.17-0.20	6.6-7.8	0-2	Moderate	0.28			
	27-60	0-5	1.60-1.75	6.0-20	0.03-0.06	7.4-8.4	0-2	Low--------	0.10			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
KhA*, KhB*:												
Kirley----------	0-5	27-30	1.25-1.35	0.6-2.0	0.19-0.22	6.1-7.3	0-2	Moderate	0.32	5	6	2-4
	5-21	35-50	1.20-1.35	0.06-0.6	0.11-0.19	6.1-7.8	0-2	High------	0.32			
	21-34	27-50	1.25-1.40	0.2-2.0	0.11-0.18	7.4-8.4	0-2	High------	0.37			
	34-60	25-40	1.25-1.40	0.2-2.0	0.14-0.17	7.4-8.4	0-2	Moderate	0.37			
Mosher----------	0-6	18-26	1.10-1.30	0.6-2.0	0.18-0.22	5.6-7.8	0-2	Low-------	0.37	2	6	1-3
	6-18	35-60	1.30-1.50	0.01-0.06	0.08-0.14	6.6-9.0	2-4	High------	0.32			
	18-60	27-40	1.20-1.45	0.06-0.2	0.08-0.14	7.4-9.0	4-16	High------	0.37			
KmA*, KmB*, KmC*:												
Kirley----------	0-5	27-30	1.25-1.35	0.6-2.0	0.19-0.22	6.1-7.3	0-2	Moderate	0.32	5	6	2-4
	5-21	35-50	1.20-1.35	0.06-0.6	0.11-0.19	6.1-7.8	0-2	High------	0.32			
	21-34	27-50	1.25-1.40	0.2-2.0	0.11-0.18	7.4-8.4	0-2	High------	0.37			
	34-60	25-40	1.25-1.40	0.2-2.0	0.14-0.17	7.4-8.4	0-2	Moderate	0.37			
Ottumwa---------	0-6	40-60	1.15-1.30	0.06-0.2	0.10-0.14	6.6-8.4	0-2	High------	0.37	4	4	2-4
	6-26	45-60	1.25-1.40	0.06-0.2	0.08-0.12	7.4-9.0	0-2	High------	0.37			
	26-60	45-60	1.25-1.40	0.06-0.2	0.08-0.12	6.6-8.4	0-2	High------	0.37			
KnD*:												
Kirley----------	0-5	27-30	1.25-1.35	0.6-2.0	0.19-0.22	6.1-7.3	0-2	Moderate	0.32	5	6	2-4
	5-21	35-50	1.20-1.35	0.06-0.6	0.11-0.19	6.1-7.8	0-2	High------	0.32			
	21-34	27-50	1.25-1.40	0.2-2.0	0.11-0.18	7.4-8.4	0-2	High------	0.37			
	34-60	25-40	1.25-1.40	0.2-2.0	0.14-0.17	7.4-8.4	0-2	Moderate	0.37			
Vivian----------	0-10	18-26	1.35-1.60	2.0-6.0	0.10-0.12	7.4-8.4	0-2	Low-------	0.24	4	4L	.5-1
	10-50	18-26	1.45-1.70	2.0-6.0	0.08-0.10	7.4-8.4	0-2	Low-------	0.24			
	50-60	---	---	0.01-0.2	---	---	---	----------	----			
Ko---------------	0-26	45-60	1.20-1.30	0.01-0.06	0.10-0.14	6.6-8.4	0-2	Very high	0.37	5	4	2-4
Kolls	26-32	60-70	1.20-1.30	0.01-0.06	0.08-0.12	7.4-8.4	0-2	Very high	0.37			
	32-60	60-70	1.35-1.50	0.01-0.06	0.08-0.12	7.4-9.0	0-2	Very high	0.37			
KyA, KyB---------	0-4	50-65	1.15-1.30	0.01-0.06	0.08-0.12	6.6-7.8	0-2	Very high	0.37	5	4	1-3
Kyle	4-27	60-65	1.15-1.30	0.01-0.06	0.08-0.12	7.4-8.4	0-4	Very high	0.37			
	27-60	60-65	1.15-1.30	0.01-0.06	0.08-0.12	7.4-8.4	2-8	Very high	0.37			
LaB, LaC, LaD----	0-5	45-60	1.05-1.15	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37	3	4	1-3
Lakoma	5-21	45-60	1.00-1.25	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37			
	21-28	45-60	1.15-1.30	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37			
	28-60	---	---	0.01-0.06	---	---	---	----------	----			
LbE*:												
Lakoma----------	0-5	45-60	1.05-1.15	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37	3	4	1-3
	5-21	45-60	1.00-1.25	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37			
	21-28	45-60	1.15-1.30	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37			
	28-60	---	---	0.01-0.06	---	---	---	----------	----			
Vivian----------	0-10	18-26	1.35-1.60	2.0-6.0	0.10-0.12	7.4-8.4	0-2	Low-------	0.24	4	4L	.5-1
	10-50	18-26	1.45-1.70	2.0-6.0	0.08-0.10	7.4-8.4	0-2	Low-------	0.24			
	50-60	---	---	0.01-0.2	---	---	---	----------	----			
Lo---------------	0-4	40-50	1.15-1.25	0.06-0.6	0.11-0.16	6.6-8.4	0-4	High------	0.28	5	4	1-3
Lohmiller	4-60	35-50	1.20-1.35	0.06-0.6	0.11-0.16	6.6-8.4	0-4	High------	0.43			
Lp---------------	0-4	40-50	1.15-1.25	0.06-0.2	0.11-0.16	6.6-8.4	0-4	High------	0.28	5	4	1-2
Lohmiller	4-60	35-50	1.20-1.35	0.06-0.6	0.11-0.16	7.4-8.4	0-4	High------	0.43			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Lv*:												
Lohmiller-------	0-4	40-50	1.15-1.25	0.06-0.6	0.11-0.16	6.6-8.4	0-4	High------	0.28	5	4	1-3
	4-60	35-50	1.20-1.35	0.06-0.6	0.11-0.16	6.6-8.4	0-4	High------	0.43			
Arvada----------	0-3	15-27	1.10-1.25	0.6-2.0	0.16-0.18	6.6-9.0	0-4	Low-------	0.43	2	6	.5-1
	3-14	35-60	1.20-1.40	0.01-0.06	0.07-0.09	7.9-9.6	0-2	High------	0.37			
	14-60	28-45	1.20-1.40	0.06-0.2	0.09-0.11	7.9-9.6	0-4	High------	0.37			
MaE-------------- Midway	0-4	30-40	1.15-1.40	0.06-0.6	0.14-0.18	6.6-8.4	2-4	Moderate	0.37	2	4L	.5-2
	4-13	35-50	1.15-1.40	0.06-0.2	0.14-0.20	7.9-9.0	2-8	High------	0.37			
	13-60	---	---	0.00-0.2	---	---	---	----------	----			
Mo--------------- Mosher	0-6	18-26	1.10-1.30	0.6-2.0	0.18-0.22	5.6-7.8	0-2	Low-------	0.37	2	6	1-3
	6-18	35-60	1.30-1.50	0.01-0.06	0.08-0.14	6.6-9.0	2-4	High------	0.32			
	18-60	27-40	1.20-1.45	0.06-0.2	0.08-0.14	7.4-9.0	4-16	High------	0.37			
Nb, Nc----------- Nimbro	0-8	27-35	1.15-1.25	0.6-2.0	0.19-0.22	7.4-8.4	0-2	Moderate	0.32	5	4L	2-4
	8-60	20-35	1.20-1.40	0.6-2.0	0.16-0.20	7.4-8.4	0-2	Moderate	0.28			
NuA, NuB, NuC---- Nunn	0-5	20-30	1.30-1.40	0.2-0.6	0.15-0.20	6.1-7.8	0-0	Moderate	0.28	5	6	1-3
	5-37	35-50	1.25-1.35	0.06-0.2	0.15-0.18	6.6-8.4	0-2	High------	0.37			
	37-60	15-30	1.25-1.40	0.2-0.6	0.10-0.18	7.4-8.4	0-2	Moderate	0.28			
NxD*:												
Nunn------------	0-5	20-30	1.30-1.40	0.2-0.6	0.15-0.20	6.1-7.8	0-0	Moderate	0.28	5	6	1-3
	5-37	35-50	1.25-1.35	0.06-0.2	0.15-0.18	6.6-8.4	0-2	High------	0.37			
	37-60	15-30	1.25-1.40	0.2-0.6	0.10-0.18	7.4-8.4	0-2	Moderate	0.28			
Nihill----------	0-9	10-27	1.15-1.25	0.6-2.0	0.12-0.16	7.4-8.4	0-0	Low-------	0.24	3	4L	.5-1
	9-60	18-30	1.30-1.40	2.0-6.0	0.06-0.10	7.4-8.4	0-4	Low-------	0.20			
ObE*:												
Okaton----------	0-4	45-60	1.05-1.25	0.06-0.2	0.11-0.16	7.4-8.4	0-2	High------	0.37	2	4	1-2
	4-14	45-60	1.10-1.25	0.06-0.2	0.11-0.16	7.4-8.4	0-2	High------	0.37			
	14-60	---	---	0.01-0.06	---	---	---	----------	----			
Lakoma----------	0-5	45-60	1.05-1.15	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37	3	4	1-3
	5-21	45-60	1.00-1.25	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37			
	21-28	45-60	1.15-1.30	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37			
	28-60	---	---	0.01-0.06	---	---	---	----------	----			
Oc--------------- Onita	0-12	20-26	1.15-1.30	0.6-2.0	0.19-0.22	5.6-7.3	0-2	Low-------	0.28	5	6	4-6
	12-37	35-50	1.20-1.40	0.2-0.6	0.16-0.19	6.1-7.3	0-2	High------	0.43			
	37-60	25-35	1.25-1.40	0.2-0.6	0.17-0.20	7.4-8.4	0-2	Moderate	0.43			
OdB, OdC, OdD---- Opal	0-6	50-60	1.20-1.30	0.01-0.06	0.10-0.14	6.6-7.8	0-2	Very high	0.37	3	4	2-4
	6-33	50-60	1.20-1.30	0.01-0.06	0.08-0.14	6.6-8.4	0-2	Very high	0.37			
	33-36	50-60	1.20-1.30	0.01-0.06	0.08-0.12	6.6-8.4	2-4	Very high	0.37			
	36-60	---	---	0.01-0.06	---	---	---	----------	----			
OeB*, OeC*:												
Opal------------	0-6	50-60	1.20-1.30	0.01-0.06	0.10-0.14	6.6-7.8	0-2	Very high	0.37	3	4	2-4
	6-33	50-60	1.20-1.30	0.01-0.06	0.08-0.14	6.6-8.4	0-2	Very high	0.37			
	33-36	50-60	1.20-1.30	0.01-0.06	0.08-0.12	6.6-8.4	2-4	Very high	0.37			
	36-60	---	---	0.01-0.06	---	---	---	----------	----			
Promise---------	0-5	50-60	1.10-1.25	0.01-0.2	0.10-0.14	6.1-7.8	0-2	Very high	0.37	5	4	2-4
	5-29	60-65	1.10-1.25	0.01-0.2	0.08-0.14	7.4-9.0	0-2	Very high	0.37			
	29-60	50-65	1.10-1.25	0.01-0.2	0.10-0.12	7.4-9.0	2-4	Very high	0.37			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Of*--------------- Orthents, clayey	0-4	18-40	1.35-1.60	2.0-6.0	0.10-0.12	7.4-8.4	0-2	Low--------	0.24	2	4L	.5-2
	4-60	---	---	0.01-0.2	---	---	---	-----------	----			
Og*--------------- Orthents, gravelly	0-4	10-20	1.25-1.40	2.0-6.0	0.11-0.20	6.1-7.8	0-2	Low--------	0.20	3	5	.5-3
	4-60	0-5	1.60-1.80	6.0-60	0.03-0.06	7.4-8.4	0-2	Low--------	0.10			
OtA, OtB---------- Ottumwa	0-6	40-60	1.15-1.30	0.06-0.2	0.10-0.14	6.6-8.4	0-2	High-------	0.37	4	4	2-4
	6-26	45-60	1.25-1.40	0.06-0.2	0.08-0.12	7.4-9.0	0-2	High-------	0.37			
	26-60	45-60	1.25-1.40	0.06-0.2	0.08-0.12	6.6-8.4	0-2	High-------	0.37			
OvA*:												
Ottumwa----------	0-6	40-60	1.15-1.30	0.06-0.2	0.10-0.14	6.6-8.4	0-2	High-------	0.37	4	4	2-4
	6-26	45-60	1.25-1.40	0.06-0.2	0.08-0.12	7.4-9.0	0-2	High-------	0.37			
	26-60	45-60	1.25-1.40	0.06-0.2	0.08-0.12	6.6-8.4	0-2	High-------	0.37			
Capa-------------	0-2	15-25	1.10-1.25	0.6-2.0	0.19-0.22	5.6-7.3	0-2	Low--------	0.37	2	6	1-2
	2-20	60-70	1.25-1.40	0.01-0.06	0.10-0.14	6.6-8.4	4-16	Very high	0.37			
	20-60	45-65	1.25-1.45	0.01-0.06	0.08-0.12	7.9-8.4	4-16	Very high	0.37			
OwB*, OwC*:												
Ottumwa----------	0-6	40-60	1.15-1.30	0.06-0.2	0.10-0.14	6.6-8.4	0-2	High-------	0.37	4	4	2-4
	6-26	45-60	1.25-1.40	0.06-0.2	0.08-0.12	7.4-9.0	0-2	High-------	0.37			
	26-60	45-60	1.25-1.40	0.06-0.2	0.08-0.12	6.6-8.4	0-2	High-------	0.37			
Lakoma-----------	0-5	45-60	1.05-1.15	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37	3	4	1-3
	5-21	45-60	1.00-1.25	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37			
	21-28	45-60	1.15-1.30	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37			
	28-60	---	---	0.01-0.06	---	---	---	-----------	----			
OxC*:												
Ottumwa----------	0-6	40-60	1.15-1.30	0.06-0.2	0.10-0.14	6.6-8.4	0-2	High-------	0.37	4	4	2-4
	6-26	45-60	1.25-1.40	0.06-0.2	0.08-0.12	7.4-9.0	0-2	High-------	0.37			
	26-60	45-60	1.25-1.40	0.06-0.2	0.08-0.12	6.6-8.4	0-2	High-------	0.37			
Razor------------	0-4	40-50	1.15-1.30	0.06-0.2	0.13-0.18	6.6-8.4	0-2	High-------	0.28	3	4	1-3
	4-14	35-60	1.20-1.40	0.06-0.2	0.12-0.17	7.4-8.4	0-2	High-------	0.37			
	14-29	35-60	1.20-1.40	0.06-0.2	0.12-0.17	7.4-8.4	0-2	High-------	0.37			
	29-60	---	---	0.01-2.0	---	---	---	-----------	----			
OyC*:												
Ottumwa----------	0-6	40-60	1.15-1.30	0.06-0.2	0.10-0.14	6.6-8.4	0-2	High-------	0.37	4	4	2-4
	6-26	45-60	1.25-1.40	0.06-0.2	0.08-0.12	7.4-9.0	0-2	High-------	0.37			
	26-60	45-60	1.25-1.40	0.06-0.2	0.08-0.12	6.6-8.4	0-2	High-------	0.37			
Razor------------	0-4	40-50	1.15-1.30	0.06-0.2	0.13-0.18	6.6-8.4	0-2	High-------	0.28	3	4	1-3
	4-14	35-60	1.20-1.40	0.06-0.2	0.12-0.17	7.4-8.4	0-2	High-------	0.37			
	14-29	35-60	1.20-1.40	0.06-0.2	0.12-0.17	7.4-8.4	0-2	High-------	0.37			
	29-60	---	---	0.01-2.0	---	---	---	-----------	----			
Savo-------------	0-6	20-26	1.10-1.25	0.6-2.0	0.19-0.22	6.1-7.3	0-0	Moderate	0.32	5	6	2-4
	6-20	35-50	1.20-1.40	0.2-0.6	0.11-0.19	6.1-7.8	0-0	High-------	0.32			
	20-35	25-35	1.20-1.40	0.2-0.6	0.11-0.19	7.4-8.4	0-2	High-------	0.43			
	35-60	20-35	1.25-1.45	0.2-2.0	0.11-0.17	7.4-8.4	0-2	Moderate	0.43			
PeC, PeD---------- Pierre	0-7	50-60	1.10-1.25	0.00-0.06	0.08-0.12	6.1-7.8	0-2	Very high	0.37	3	4	1-3
	7-27	50-60	1.10-1.25	0.00-0.06	0.08-0.12	6.6-8.4	0-2	Very high	0.37			
	27-60	---	---	0.01-0.2	---	---	---	-----------	----			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
PkE*:												
Pierre----------	0-7	50-60	1.10-1.25	0.00-0.06	0.08-0.12	6.1-7.8	0-2	Very high	0.37	3	4	1-3
	7-27	50-60	1.10-1.25	0.00-0.06	0.08-0.12	6.6-8.4	0-2	Very high	0.37			
	27-60	---	---	0.01-0.2	---	---	---	----------	----			
Samsil----------	0-4	45-60	1.15-1.30	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37	2	4	1-2
	4-14	50-65	1.15-1.30	0.06-0.2	0.08-0.12	7.4-8.4	0-4	Very high	0.37			
	14-60	---	---	---	---	---	---	----------	----			
PrA, PrB--------- Promise	0-5	50-60	1.10-1.25	0.01-0.2	0.10-0.14	6.1-7.8	0-2	Very high	0.37	5	4	2-4
	5-29	60-65	1.10-1.25	0.01-0.2	0.08-0.14	7.4-9.0	0-2	Very high	0.37			
	29-60	50-65	1.10-1.25	0.01-0.2	0.10-0.12	7.4-9.0	2-4	Very high	0.37			
RaB, RaC--------- Razor	0-4	40-50	1.15-1.30	0.06-0.2	0.13-0.18	6.6-8.4	0-2	High------	0.28	3	4	1-3
	4-14	35-60	1.20-1.40	0.06-0.2	0.12-0.17	7.4-8.4	0-2	High------	0.37			
	14-29	35-60	1.20-1.40	0.06-0.2	0.12-0.17	7.4-8.4	0-2	High------	0.37			
	29-60	---	---	0.01-2.0	---	---	---	----------	----			
RbD*:												
Razor-----------	0-4	40-50	1.15-1.30	0.06-0.2	0.13-0.18	6.6-8.4	0-2	High------	0.28	3	4	1-3
	4-14	35-60	1.20-1.40	0.06-0.2	0.12-0.17	7.4-8.4	0-2	High------	0.37			
	14-29	35-60	1.20-1.40	0.06-0.2	0.12-0.17	7.4-8.4	0-2	High------	0.37			
	29-60	---	---	0.01-2.0	---	---	---	----------	----			
Midway----------	0-4	30-40	1.15-1.40	0.06-0.6	0.14-0.18	6.6-8.4	2-4	Moderate	0.37	2	4L	.5-2
	4-13	35-50	1.15-1.40	0.06-0.2	0.14-0.20	7.9-9.0	2-8	High------	0.37			
	13-60	---	---	0.00-2.0	---	---	---	----------	----			
RdD*:												
Razor-----------	0-4	40-50	1.15-1.30	0.06-0.2	0.13-0.18	6.6-8.4	0-2	High------	0.28	3	4	1-3
	4-14	35-60	1.20-1.40	0.06-0.2	0.12-0.17	7.4-8.4	0-2	High------	0.37			
	14-29	35-60	1.20-1.40	0.06-0.2	0.12-0.17	7.4-8.4	0-2	High------	0.37			
	29-60	---	---	0.01-2.0	---	---	---	----------	----			
Shingle---------	0-4	28-35	1.10-1.20	0.6-2.0	0.19-0.21	7.4-9.0	0-2	Moderate	0.32	2	4L	1-3
	4-17	20-35	1.20-1.30	0.6-2.0	0.17-0.20	7.4-9.0	0-2	Moderate	0.32			
	17-60	---	---	---	---	---	---	----------	----			
ReA, ReB--------- Ree	0-8	22-26	1.15-1.30	0.6-2.0	0.18-0.22	6.1-7.3	0-2	Low-------	0.28	5	6	2-4
	8-21	27-35	1.20-1.35	0.6-2.0	0.17-0.22	6.6-8.4	0-2	Moderate	0.28			
	21-45	15-35	1.30-1.50	0.6-2.0	0.09-0.20	7.4-8.4	0-2	Moderate	0.28			
	45-60	5-10	1.45-1.65	6.0-20	0.06-0.10	7.4-8.4	0-2	Low-------	0.17			
RfB*, RfC*:												
Ree-------------	0-8	22-26	1.15-1.30	0.6-2.0	0.18-0.22	6.1-7.3	0-2	Low-------	0.28	5	6	2-4
	8-21	27-35	1.20-1.35	0.6-2.0	0.17-0.22	6.6-8.4	0-2	Moderate	0.28			
	21-45	15-35	1.30-1.50	0.6-2.0	0.09-0.20	7.4-8.4	0-2	Moderate	0.28			
	45-60	5-10	1.45-1.65	6.0-20	0.06-0.10	7.4-8.4	0-2	Low-------	0.17			
Canning---------	0-6	20-26	1.15-1.30	0.6-2.0	0.18-0.20	6.1-7.3	0-2	Low-------	0.28	4	6	2-4
	6-27	27-35	1.25-1.35	0.6-2.0	0.17-0.20	6.6-7.8	0-2	Moderate	0.28			
	27-60	0-5	1.60-1.75	6.0-20	0.03-0.06	7.4-8.4	0-2	Low-------	0.10			
Rh*:												
Ree-------------	0-8	22-26	1.15-1.30	0.6-2.0	0.18-0.22	6.1-7.3	0-2	Low-------	0.28	5	6	2-4
	8-21	27-35	1.20-1.35	0.6-2.0	0.17-0.22	6.6-8.4	0-2	Moderate	0.28			
	21-45	15-35	1.30-1.50	0.6-2.0	0.09-0.20	7.4-8.4	0-2	Moderate	0.28			
	45-60	5-10	1.45-1.65	6.0-20	0.06-0.10	7.4-8.4	0-2	Low-------	0.17			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Rh*:												
Hoven	0-3	22-26	1.15-1.25	0.6-2.0	0.19-0.22	5.6-7.3	0-2	Low	0.37	2	6	2-4
	3-7	35-60	1.15-1.30	0.01-0.06	0.10-0.19	6.1-7.8	4-16	High	0.37			
	7-23	35-60	1.15-1.30	0.01-0.06	0.10-0.19	6.6-8.4	4-16	High	0.37			
	23-60	35-60	1.30-1.50	0.01-0.2	0.08-0.17	7.4-9.0	4-16	High	0.37			
RkD*:												
Ree	0-8	22-26	1.15-1.30	0.6-2.0	0.18-0.22	6.1-7.3	0-2	Low	0.28	5	6	2-4
	8-21	27-35	1.20-1.35	0.6-2.0	0.17-0.22	6.6-8.4	0-2	Moderate	0.28			
	21-45	15-35	1.30-1.50	0.6-2.0	0.09-0.20	7.4-8.4	0-2	Moderate	0.28			
	45-60	5-10	1.45-1.65	6.0-20	0.06-0.10	7.4-8.4	0-2	Low	0.17			
Vivian	0-10	18-26	1.35-1.60	2.0-6.0	0.10-0.12	7.4-8.4	0-2	Low	0.24	4	4L	.5-1
	10-50	18-26	1.45-1.70	2.0-6.0	0.08-0.10	7.4-8.4	0-2	Low	0.24			
	50-60	---	---	0.01-0.2	---	---	---	---	---			
Rv*. Riverwash	0-4	0-5	1.65-1.75	2.0-20	0.04-0.06	7.4-8.4	0-2	Low	0.15	1	1	.5-1
	4-60	0-5	1.65-1.75	2.0-20	0.04-0.06	7.4-8.4	0-2	Low	0.15			
SbF. Samsil	0-4	45-60	1.15-1.30	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37	2	4	1-2
	4-14	50-65	1.15-1.30	0.06-0.2	0.08-0.12	7.4-8.4	0-4	Very high	0.37			
	14-60	---	---	---	---	---	---	---	---			
ScF*:												
Samsil	0-4	45-60	1.15-1.30	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37	2	4	1-2
	4-14	50-65	1.15-1.30	0.06-0.2	0.08-0.12	7.4-8.4	0-4	Very high	0.37			
	14-60	---	---	---	---	---	---	---	---			
Nihill	0-9	10-27	1.15-1.25	0.6-2.0	0.12-0.16	7.4-8.4	0-0	Low	0.24	3	4L	.5-1
	9-60	18-30	1.30-1.40	2.0-6.0	0.06-0.10	7.4-8.4	0-4	Low	0.20			
SdF*:												
Samsil	0-4	45-60	1.15-1.30	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37	2	4	1-2
	4-14	50-65	1.15-1.30	0.06-0.2	0.08-0.12	7.4-8.4	0-4	Very high	0.37			
	14-60	---	---	---	---	---	---	---	---			
Rock outcrop	0-60	50-60	1.30-1.40	0.01-0.06	0.08-0.12	5.6-8.4	0-2	High	0.10	1	4	.5-1
SoE*:												
Sansarc	0-4	55-65	1.10-1.20	0.06-0.2	0.08-0.12	6.6-8.4	0-2	Very high	0.37	2	4	1-2
	4-15	55-65	1.10-1.20	0.06-0.2	0.06-0.12	7.4-8.4	0-2	Very high	0.37			
	15-60	---	---	0.01-0.2	---	---	---	---	---			
Opal	0-6	50-60	1.20-1.30	0.01-0.06	0.10-0.14	6.6-7.8	0-2	Very high	0.37	3	4	2-4
	6-33	50-60	1.20-1.30	0.01-0.06	0.08-0.14	6.6-8.4	0-2	Very high	0.37			
	33-36	50-60	1.20-1.30	0.01-0.06	0.08-0.12	6.6-8.4	2-4	Very high	0.37			
	36-60	---	---	0.01-0.06	---	---	---	---	---			
SrA, SrB, SrC. Savo	0-6	20-26	1.10-1.25	0.6-2.0	0.19-0.22	6.1-7.3	0-0	Moderate	0.32	5	6	2-4
	6-20	35-50	1.20-1.40	0.2-0.6	0.11-0.19	6.1-7.8	0-0	High	0.32			
	20-35	25-35	1.20-1.40	0.2-0.6	0.11-0.19	7.4-8.4	0-2	High	0.43			
	35-60	20-35	1.25-1.45	0.2-2.0	0.11-0.17	7.4-8.4	0-2	Moderate	0.43			
StF*:												
Schamber	0-6	18-25	1.40-1.60	6.0-20	0.03-0.06	6.1-8.4	0-2	Low	0.20	2	6	.5-2
	6-60	2-10	1.40-1.65	6.0-20	0.03-0.06	7.4-8.4	0-2	Low	0.05			
Samsil	0-4	45-60	1.15-1.30	0.06-0.2	0.08-0.12	7.4-8.4	0-2	Very high	0.37	2	4	1-2
	4-14	50-65	1.15-1.30	0.06-0.2	0.08-0.12	7.4-8.4	0-4	Very high	0.37			
	14-60	---	---	---	---	---	---	---	---			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
SuE--------------- Shingle	0-4	28-35	1.10-1.20	0.6-2.0	0.19-0.21	7.4-9.0	0-2	Moderate	0.32	1	4L	1-3
	4-17	20-35	1.20-1.30	0.6-2.0	0.17-0.20	7.4-9.0	0-2	Moderate	0.32			
	17-60	---	---	---	---	---	---	----------	----			
SwE*:												
Shingle----------	0-4	28-35	1.10-1.20	0.6-2.0	0.19-0.21	7.4-9.0	0-2	Moderate	0.32	2	4L	1-3
	4-17	20-35	1.20-1.30	0.6-2.0	0.17-0.20	7.4-9.0	0-2	Moderate	0.32			
	17-60	---	---	---	---	---	---	----------	----			
Razor------------	0-4	40-50	1.15-1.30	0.06-0.2	0.13-0.18	6.6-8.4	0-2	High------	0.28	3	4	1-3
	4-14	35-60	1.20-1.40	0.06-0.2	0.12-0.17	7.4-8.4	0-2	High------	0.37			
	14-29	35-60	1.20-1.40	0.06-0.2	0.12-0.17	7.4-8.4	0-2	High------	0.37			
	29-60	---	---	0.01-2.0	---	---	---	----------	----			
Wc---------------- Wendte	0-6	40-60	1.15-1.25	0.06-0.2	0.13-0.18	7.4-8.4	0-2	Very high	0.37	5	4	2-4
	6-60	45-55	1.20-1.40	0.06-0.2	0.11-0.17	7.4-8.4	0-2	Very high	0.37			
Wd*:												
Wendte-----------	0-6	40-60	1.15-1.25	0.06-0.2	0.13-0.18	7.4-8.4	0-2	Very high	0.37	5	4	3-5
	6-60	45-55	1.20-1.40	0.06-0.2	0.11-0.17	7.4-8.4	0-2	Very high	0.37			
Herdcamp---------	0-5	40-55	1.15-1.25	0.06-0.2	0.13-0.18	7.4-8.4	2-4	Very high	0.28	5	4	3-5
	5-60	37-55	1.15-1.40	0.06-0.2	0.08-0.19	7.4-8.4	2-8	Very high	0.28			
WsE*:												
Wendte-----------	0-6	40-60	1.15-1.25	0.06-0.2	0.13-0.18	7.4-8.4	0-2	Very high	0.37	5	4	3-5
	6-60	45-55	1.20-1.40	0.06-0.2	0.11-0.17	7.4-8.4	0-2	Very high	0.37			
Sansarc----------	0-4	55-65	1.10-1.20	0.06-0.2	0.08-0.12	6.6-8.4	0-2	Very high	0.37	2	4	1-2
	4-15	55-65	1.10-1.20	0.06-0.2	0.06-0.12	7.4-8.4	0-2	Very high	0.37			
	15-60	---	---	0.01-0.2	---	---	---	----------	----			
Ww*:												
Wortman----------	0-5	10-20	1.15-1.30	0.6-2.0	0.20-0.22	6.1-7.8	0-2	Low-------	0.37	2	6	2-4
	5-13	35-50	1.05-1.15	0.01-0.06	0.08-0.14	6.6-8.4	4-16	High------	0.28			
	13-36	15-26	1.20-1.30	0.2-0.6	0.13-0.15	7.4-9.0	2-16	Moderate	0.37			
	36-60	---	---	0.06-0.6	---	---	---	----------	----			
Wanblee----------	0-2	15-25	1.15-1.25	0.6-2.0	0.20-0.22	5.6-7.3	0-2	Low-------	0.37	2	6	2-5
	2-9	35-45	1.05-1.25	0.01-0.06	0.10-0.16	6.6-7.8	2-16	High------	0.32			
	9-27	15-30	1.15-1.30	0.2-0.6	0.13-0.17	7.9-9.0	4-16	Moderate	0.32			
	27-60	---	---	0.06-0.6	---	---	---	----------	----			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

("Flooding," "water table," and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
Ab: Albaton	D	Frequent	Brief	Mar-Oct	+4.-2.0	Apparent	Nov-Jul	>60	---	High	High	Low.
Ar: Arvada	D	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
As*:												
Arvada	D	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Slickspots	D	None	---	---	>6.0	---	---	>60	---	High	High	Moderate.
Bc: Bankard	A	Rare	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
Bd: Bankard	A	Occasional	Brief	Mar-Jun	>6.0	---	---	>60	---	Low	High	Low.
BkA, BkB: Blackpipe	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
Bo*:												
Blackpipe	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
Wortman	D	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Moderate.
Bu: Bullcreek	D	None	---	---	>6.0	---	---	>60	---	Low	High	High.
Bx*:												
Bullcreek	D	None	---	---	>6.0	---	---	>60	---	Low	High	High.
Slickspots	D	None	---	---	>6.0	---	---	>60	---	High	High	Moderate.
Ca: Canning	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
CbA: Capa	D	None	---	---	3.5-5.0	Perched	Jan-Jun	>60	---	Low	High	Moderate.
Cc*:												
Capa	D	None	---	---	3.5-5.0	Perched	Jan-Jun	>60	---	Low	High	Moderate.
Slickspots	D	None	---	---	>6.0	---	---	>60	---	High	High	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Ct*:												
Capa	D	None	---	---	3.5-5.0	Perched	Jan-Jun	>60	---	Low	High	Moderate.
Wendte	D	Occasional	Brief	Apr-Oct	3.5-5.0	Apparent	Mar-Jun	>60	---	Low	High	Low.
Cv Craft	B	Rare	---	---	>6.0	---	---	>60	---	Low	High	Low.
Eg Egas	D	Occasional	Brief	Apr-Oct	0-1.5	Apparent	Oct-Jun	>60	---	High	High	Moderate.
Ha Haverson	B	Rare	---	---	>6.0	---	---	>60	---	Low	High	Low.
Hb Haverson	B	Frequent	Brief	Apr-Jun	>6.0	---	---	>60	---	Low	High	Low.
Hc*:												
Haverson	B	Rare	---	---	>6.0	---	---	>60	---	Low	High	Low.
Craft	B	Rare	---	---	>6.0	---	---	>60	---	Low	High	Low.
Ho Hilmoe	C	Rare	---	---	>6.0	---	---	>60	---	Low	High	High.
HpB Hisle	D	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Moderate.
Hv Hoven	D	None	---	---	+1-1.5	Perched	Mar-Jul	>60	---	Moderate	High	Moderate.
KeA, KeB, KeD Kirley	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
KfB*:												
Kirley	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Canning	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
KhA*, KhB*:												
Kirley	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Mosher	D	None	---	---	3.0-5.0	Perched	Oct-Jun	>60	---	Moderate	High	Moderate.
KmA*, KmB*, KmC*:												
Kirley	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Ottumwa	D	None	---	---	>6.0	---	---	40->60	Soft	Low	High	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
KnD*:												
Kirley-----------	C	None---------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.
Vivian-----------	B	None---------	---	---	>6.0	---	---	40-60	Soft	Low------	High-----	Low.
Ko---------------- Kolls	D	None---------	---	---	0-1.5	Perched	Apr-Jun	>60	---	Moderate	High-----	Moderate.
KyA, KyB---------- Kyle	D	None---------	---	---	>6.0	---	---	>60	---	Low------	High-----	Moderate.
LaB, LaC, LaD----- Lakoma	D	None---------	---	---	>6.0	---	---	20-40	Soft	Low------	High-----	Moderate.
LbE*:												
Lakoma-----------	D	None---------	---	---	>6.0	---	---	20-40	Soft	Low------	High-----	Moderate.
Vivian-----------	B	None---------	---	---	>6.0	---	---	40-60	Soft	Low------	High-----	Low.
Lo---------------- Lohmiller	C	Rare---------	---	---	>6.0	---	---	>60	---	Low------	High-----	Moderate.
Lp---------------- Lohmiller	C	Occasional	Brief-----	Mar-Sep	>6.0	---	---	>60	---	Low------	High-----	Moderate.
Lv*:												
Lohmiller--------	C	Rare---------	---	---	>6.0	---	---	>60	---	Low------	High-----	Moderate.
Arvada-----------	D	None---------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.
MaE--------------- Midway	D	None---------	---	---	>6.0	---	---	10-20	Soft	Low------	High-----	Low.
Mo---------------- Mosher	D	None---------	---	---	3.0-5.0	Perched	Oct-Jun	>60	---	Moderate	High-----	Moderate.
Nb---------------- Nimbro	B	Rare---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
Nc---------------- Nimbro	B	Frequent----	Brief-----	Apr-Oct	3.5-5.0	Apparent	Mar-May	>60	---	Moderate	High-----	Low.
NuA, NuB, NuC----- Nunn	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
NxD*:												
Nunn-------------	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
NxD*:												
Nihill-----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
ObE*:												
Okaton-----------	D	None--------	---	---	>6.0	---	---	10-20	Soft	Low------	High-----	High.
Lakoma-----------	D	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	High-----	Moderate.
Oc---------------- Onita	C	None--------	---	---	2.5-6.0	Perched	Apr-Jun	>60	---	High-----	High-----	Low.
OdB, OdC, OdD----- Opal	D	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	High-----	Moderate.
OeB*, OeC*:												
Opal-------------	D	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	High-----	Moderate.
Promise----------	D	None--------	---	---	>6.0	---	---	40-60	Soft	Low------	High-----	Low.
Of*--------------- Orthents, clayey	C	None--------	---	---	>6.0	---	---	5-10	Soft	Low------	Low------	Low.
Og*--------------- Orthents, gravelly	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
OtA, OtB---------- Ottumwa	D	None--------	---	---	>6.0	---	---	40->60	Soft	Low------	High-----	Low.
OvA*:												
Ottumwa----------	D	None--------	---	---	>6.0	---	---	40->60	Soft	Low------	High-----	Low.
Capa-------------	D	None--------	---	---	3.5-5.0	Perched	Jan-Jun	>60	---	Low------	High-----	Moderate.
OwB*, OwC*:												
Ottumwa----------	D	None--------	---	---	>6.0	---	---	40->60	Soft	Low------	High-----	Low.
Lakoma-----------	D	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	High-----	Moderate.
OxC*:												
Ottumwa----------	D	None--------	---	---	>6.0	---	---	40->60	Soft	Low------	High-----	Low.
Razor------------	C	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	High-----	Low.
OyC*:												
Ottumwa----------	D	None--------	---	---	>6.0	---	---	40->60	Soft	Low------	High-----	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
OyC*:												
Razor	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
Savo	C	None	---	---	>6.0	---	---	>60	---	Low	High	Moderate.
PeC, PeD Pierre	D	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Moderate.
PkE*:												
Pierre	D	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Moderate.
Samsil	D	None	---	---	>6.0	---	---	10-20	Soft	Low	High	Moderate.
PrA, PrB Promise	D	None	---	---	>6.0	---	---	40-60	Soft	Low	High	Low.
RaB, RaC Razor	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
RbD*:												
Razor	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
Midway	D	None	---	---	>6.0	---	---	10-20	Soft	Low	High	Low.
RdD*:												
Razor	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
Shingle	D	None	---	---	>6.0	---	---	10-20	Soft	Low	High	Low.
ReA, ReB Ree	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
RfB*, RfC*:												
Ree	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Canning	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
Rh*:												
Ree	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Hoven	D	None	---	---	+1-1.5	Perched	Mar-Jul	>60	---	Moderate	High	Moderate.
RkD*:												
Ree	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Vivian	B	None	---	---	>6.0	---	---	40-60	Soft	Low	High	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
Rv*----------------- Riverwash	A	Frequent----	Brief-----	Mar-Nov	0-3.0	Apparent	Mar-Nov	>60	---	Low------	Low------	Low.
SbF----------------- Samsil	D	None--------	---	---	>6.0	---	---	10-20	Soft	Low------	High-----	Moderate.
ScF*:												
Samsil-----------	D	None--------	---	---	>6.0	---	---	10-20	Soft	Low------	High-----	Moderate.
Nihill-----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
SdF*:												
Samsil-----------	D	None--------	---	---	>6.0	---	---	10-20	Soft	Low------	High-----	Moderate.
Rock outcrop-----	D	None--------	---	---	>6.0	---	---	0-1	Soft	Low------	Moderate	Low.
SoE*:												
Sansarc----------	D	None--------	---	---	>6.0	---	---	10-20	Soft	Low------	High-----	Moderate.
Opal-------------	D	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	High-----	Moderate.
SrA, SrB, SrC----- Savo	C	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Moderate.
StF*:												
Schamber---------	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
Samsil-----------	D	None--------	---	---	>6.0	---	---	10-20	Soft	Low------	High-----	Moderate.
SuE--------------- Shingle	D	None--------	---	---	>6.0	---	---	10-20	Soft	Low------	High-----	Low.
SwE*:												
Shingle----------	D	None--------	---	---	>6.0	---	---	10-20	Soft	Low------	High-----	Low.
Razor------------	C	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	High-----	Low.
Wc---------------- Wendte	D	Rare--------	---	---	3.5-5.0	Apparent	Mar-Jun	>60	---	Low------	High-----	Low.
Wd*:												
Wendte-----------	D	Occasional	Brief-----	Apr-Oct	3.5-5.0	Apparent	Mar-Jun	>60	---	Low------	High-----	Low.
Herdcamp---------	D	Frequent----	Brief-----	Mar-Nov	0-1.0	Apparent	Apr-Oct	>60	---	High-----	High-----	Moderate.
WsE*:												
Wendte-----------	D	Occasional	Brief-----	Apr-Oct	3.5-5.0	Apparent	Mar-Jun	>60	---	Low------	High-----	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
WsE*:												
Sansarc----------	D	None--------	---	---	>6.0	---	---	10-20	Soft	Low------	High-----	Moderate.
Ww*:												
Wortman----------	D	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	High-----	Moderate.
Wanblee----------	D	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	High-----	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Albaton	Very fine, montmorillonitic (calcareous), mesic Vertic Fluvaquents
Arvada	Fine, montmorillonitic, mesic Ustic Natrargids
Bankard	Sandy, mixed, mesic Ustic Torrifluvents
Blackpipe	Fine, montmorillonitic, mesic Aridic Argiustolls
Bullcreek	Very fine, montmorillonitic, mesic Udic Chromusterts
Canning	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Argiustolls
Capa	Very fine, montmorillonitic, mesic Vertic Natrustolls
Craft	Coarse-silty, mixed (calcareous), mesic Aridic Ustifluvents
Egas	Fine, montmorillonitic (calcareous), mesic Typic Haplaquolls
Haverson	Fine-loamy, mixed (calcareous), mesic Aridic Ustifluvents
Herdcamp	Fine, montmorillonitic (calcareous), mesic Vertic Endoaquolls
*Hilmoe	Clayey over loamy, montmorillonitic, mesic Fluventic Haplustolls
Hisle	Fine, montmorillonitic, mesic Ustollic Natrargids
Hoven	Fine, montmorillonitic, mesic Vertic Natraquolls
Kirley	Fine, montmorillonitic, mesic Vertic Argiustolls
Kolls	Very fine, montmorillonitic (calcareous), mesic Typic Epiaquerts
Kyle	Very fine, montmorillonitic, mesic Aridic Haplusterts
Lakoma	Fine, montmorillonitic, mesic Typic Ustochrepts
Lohmiller	Fine, montmorillonitic (calcareous), mesic Ustic Torrifluvents
Midway	Clayey, montmorillonitic (calcareous), mesic, shallow Ustic Torriorthents
Mosher	Fine, montmorillonitic, mesic Vertic Natrustolls
Nihill	Loamy-skeletal, mixed (calcareous), mesic Ustic Torriorthents
*Nimbro	Fine-loamy, mixed (calcareous), mesic Mollic Ustifluvents
Nunn	Fine, montmorillonitic, mesic Aridic Argiustolls
Okaton	Clayey, montmorillonitic (calcareous), mesic, shallow Typic Ustorthents
Onita	Fine, montmorillonitic, mesic Pachic Argiustolls
Opal	Fine, montmorillonitic, mesic Leptic Udic Haplusterts
Orthents	Orthents
Ottumwa	Fine, montmorillonitic, mesic Vertic Haplustolls
Pierre	Fine, montmorillonitic, mesic Aridic Haplusterts
Promise	Very fine, montmorillonitic, mesic Udic Chromusterts
Razor	Fine, montmorillonitic, mesic Ustollic Camborthids
Ree	Fine-loamy, mixed, mesic Typic Argiustolls
Samsil	Clayey, montmorillonitic (calcareous), mesic, shallow Ustic Torriorthents
Sansarc	Clayey, montmorillonitic (calcareous), mesic, shallow Typic Ustorthents
Savo	Fine, montmorillonitic, mesic Aridic Argiustolls
Schamber	Sandy-skeletal, mixed, mesic Ustic Torriorthents
Shingle	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Vivian	Loamy-skeletal, mixed (calcareous), mesic Typic Ustorthents
Wanblee	Fine, montmorillonitic, mesic Ustollic Natrargids
Wendte	Fine, montmorillonitic (calcareous), mesic Vertic Ustifluvents
Wortman	Fine, montmorillonitic, mesic Aridic Natrustolls

Interpretive Groups

INTERPRETIVE GROUPS

Map symbol and soil name	Land capability unit	Range site	Windbreak suitability group	Pasture suitability group
Ab----------------- Albaton	IVw-1	Clayey Overflow----	10	B2
Ar----------------- Arvada	VIs-1	Thin Claypan-------	10	NS
As:				
Arvada------------	VIs-1	Thin Claypan-------	10	NS
Slickspots--------	VIII-3	None---------------	10	NS
Bc----------------- Bankard	VIe-8	Sands--------------	7	NS
Bd----------------- Bankard	VIe-8	Sandy--------------	5	H
BkA---------------- Blackpipe	IIc-2	Silty--------------	6	F
BkB---------------- Blackpipe	IIe-1	Silty--------------	6	F
Bo:				
Blackpipe---------	IIc-2	Silty--------------	6	F
Wortman-----------	IVs-2	Claypan------------	9	C
Bu----------------- Bullcreek	VIs-5	Dense Clay---------	10	NS
Bx:				
Bullcreek---------	VIs-5	Dense Clay---------	10	NS
Slickspots--------	VIIIs-3	None---------------	10	NS
Ca----------------- Canning	IIIs-2	Silty--------------	6	D1
CbA---------------- Capa	VIs-1	Thin Claypan-------	10	NS
Cc:				
Capa--------------	VIs-1	Thin Claypan-------	10	NS
Slickspots--------	VIIIs-3	None---------------	10	NS
Ct:				
Capa--------------	VIs-1	Thin Claypan-------	10	NS
Wendte------------	VIw-1	Clayey Overflow----	4	NS
Cv----------------- Craft	IIc-1	Loamy Terrace------	1	F
Eg----------------- Egas	VIs-1	Saline Lowland-----	10	J
Ha----------------- Haverson	IIc-1	Loamy Terrace------	1	F
Hb----------------- Haverson	VIw-1	Loamy Overflow-----	1	NS
Hc----------------- Haverson-Craft	IIc-1	Loamy Terrace------	1	F
Ho----------------- Hilmoe	IIIs-3	Clayey Overflow----	4	I

INTERPRETIVE GROUPS--Continued

Map symbol and soil name	Land capability unit	Range site	Windbreak suitability group	Pasture suitability group
HpB----------------- Hisle	VIs-3	Thin Claypan-------	10	NS
Hv------------------ Hoven	VIs-1	Closed Depression--	10	B2
KeA----------------- Kirley	IIc-2	Clayey-------------	3	F
KeB----------------- Kirley	IIe-1	Clayey-------------	3	F
KeD----------------- Kirley	IVe-1	Clayey-------------	3	F
KfB:				
Kirley------------	IIe-1	Clayey-------------	3	F
Canning-----------	IIIe-6	Silty--------------	6	D1
KhA:				
Kirley------------	IIc-2	Clayey-------------	3	F
Mosher------------	IVs-2	Claypan------------	9	C
KhB:				
Kirley------------	IIe-1	Clayey-------------	3	F
Mosher------------	IVs-3	Claypan------------	9	C
KmA:				
Kirley------------	IIc-2	Clayey-------------	3	F
Ottumwa-----------	IIIs-3	Clayey-------------	4	I
KmB:				
Kirley------------	IIe-1	Clayey-------------	3	F
Ottumwa-----------	IIIe-3	Clayey-------------	4	I
KmC:				
Kirley------------	IIIe-1	Clayey-------------	3	F
Ottumwa-----------	IVe-7	Clayey-------------	4	I
KnD:				
Kirley------------	IVe-1	Clayey-------------	3	F
Vivian------------	VIe-5	Thin Upland--------	10	NS
Ko------------------ Kolls	Vw-4	Closed Depression--	10	B2
KyA----------------- Kyle	IIIs-3	Clayey-------------	4	I
KyB----------------- Kyle	IIIe-4	Clayey-------------	4	I
LaB----------------- Lakoma	IIIe-4	Thin Upland--------	8	I
LaC----------------- Lakoma	IVe-4	Thin Upland--------	8	I
LaD----------------- Lakoma	VIe-4	Thin Upland--------	10	I

INTERPRETIVE GROUPS--Continued

Map symbol and soil name	Land capability unit	Range site	Windbreak suitability group	Pasture suitability group
LbE:				
Lakoma------------	VIe-4	Thin Upland--------	10	I
Vivian------------	VIs-5	Thin Upland--------	10	NS
Lo----------------- Lohmiller	IIc-1	Loamy Terrace------	1	F
Lp----------------- Lohmiller	VIw-1	Loamy Overflow-----	1	NS
Lv:				
Lohmiller---------	IIc-1	Loamy Terrace------	1	F
Arvada------------	VIs-3	Thin Claypan-------	10	NS
MaE---------------- Midway	VIIe-5	Shallow Clay-------	10	NS
Mo----------------- Mosher	IVs-2	Claypan------------	9	C
Nb----------------- Nimbro	IIc-1	Loamy Terrace------	1	F
Nc----------------- Nimbro	VIw-1	Loamy Overflow-----	1	NS
NuA---------------- Nunn	IIc-2	Silty--------------	3	F
NuB---------------- Nunn	IIe-1	Silty--------------	3	F
NuC---------------- Nunn	IIIe-1	Silty--------------	3	F
NxD:				
Nunn--------------	IVe-1	Silty--------------	3	F
Nihill------------	VIs-4	Very Shallow-------	10	NS
ObE:				
Okaton------------	VIIe-8	Shallow------------	10	NS
Lakoma------------	VIe-4	Thin Upland--------	10	NS
Oc----------------- Onita	IIc-3	Loamy Overflow-----	1	K
OdB---------------- Opal	IIIe-4	Clayey-------------	4	I
OdC---------------- Opal	IVe-4	Clayey-------------	4	I
OdD---------------- Opal	VIe-4	Clayey-------------	4	I
OeB---------------- Opal-Promise	IIIe-4	Clayey-------------	4	I
OeC---------------- Opal-Promise	IVe-4	Clayey-------------	4	I
Of, Og------------- Orthents	VIIIs-2	None---------------	10	NS

INTERPRETIVE GROUPS--Continued

Map symbol and soil name	Land capability unit	Range site	Windbreak suitability group	Pasture suitability group
OtA----------------- Ottumwa	IIIs-3	Clayey-------------	4	I
OtB----------------- Ottumwa	IIIe-3	Clayey-------------	4	I
OvA:				
Ottumwa------------	IIIs-3	Clayey-------------	4	I
Capa---------------	VIs-1	Thin Claypan-------	10	NS
OwB:				
Ottumwa------------	IIIe-3	Clayey-------------	4	I
Lakoma-------------	IIIe-4	Thin Upland--------	8	I
OwC:				
Ottumwa------------	IVe-7	Clayey-------------	4	I
Lakoma-------------	IVe-4	Thin Upland--------	8	I
OxC:				
Ottumwa------------	IVe-7	Clayey-------------	4	I
Razor--------------	IVe-4	Clayey-------------	4	I
OyC:				
Ottumwa------------	IVe-7	Clayey-------------	4	I
Razor--------------	VIe-4	Clayey-------------	4	I
Savo---------------	IIIe-1	Silty--------------	3	F
PeC----------------- Pierre	IVe-4	Clayey-------------	4	I
PeD----------------- Pierre	VIe-4	Clayey-------------	4	I
PkE:				
Pierre-------------	VIe-4	Clayey-------------	10	NS
Samsil-------------	VIe-12	Shallow Clay-------	10	NS
PrA----------------- Promise	IIIs-3	Clayey-------------	4	I
PrB----------------- Promise	IIIe-4	Clayey-------------	4	I
RaB----------------- Razor	IVe-4	Clayey-------------	4	I
RaC----------------- Razor	IVe-14	Clayey-------------	4	I
RbD:				
Razor--------------	VIe-4	Clayey-------------	4	I
Midway-------------	VIe-12	Shallow Clay-------	10	NS
RdD:				
Razor--------------	VIe-4	Clayey-------------	4	I
Shingle------------	VIe-11	Shallow------------	10	NS
ReA----------------- Ree	IIc-2	Silty--------------	3	F
ReB----------------- Ree	IIe-1	Silty--------------	3	F

INTERPRETIVE GROUPS--Continued

Map symbol and soil name	Land capability unit	Range site	Windbreak suitability group	Pasture suitability group
RfB:				
Ree	IIe-1	Silty	3	F
Canning	IIIe-6	Silty	6	D1
RfC:				
Ree	IIIe-1	Silty	3	F
Canning	IVe-5	Silty	6	D1
Rh:				
Ree	IIc-2	Silty	3	F
Hoven	VIs-1	Closed Depression	10	B2
RkD:				
Ree	IIIe-1	Silty	3	F
Vivian	VIe-5	Thin Upland	10	NS
Rv Riverwash	VIIIe-1	None	10	NS
SbF Samsil	VIIe-8	Shallow Clay	10	NS
ScF:				
Samsil	VIIe-8	Shallow Clay	10	NS
Nihill	VIIs-4	Very Shallow	10	NS
SdF:				
Samsil	VIIe-8	Shallow Clay	10	NS
Rock outcrop	VIIIs-1	None	10	NS
SoE:				
Sansarc	VIIe-8	Shallow Clay	10	NS
Opal	VIe-4	Clayey	10	NS
SrA Savo	IIc-2	Silty	3	F
SrB Savo	IIe-1	Silty	3	F
SrC Savo	IIIe-1	Silty	3	F
StF:				
Schamber	VIIs-4	Very Shallow	10	NS
Samsil	VIIe-8	Shallow Clay	10	NS
SuE Shingle	VIIe-7	Shallow	10	NS
SwE:				
Shingle	VIe-7	Shallow	10	NS
Razor	VIe-4	Clayey	10	NS
Wc Wendte	IIIs-3	Clayey Overflow	4	I
Wd:				
Wendte	VIw-1	Clayey Overflow	4	NS
Herdcamp	VIw-2	Wetland	10	NS
WsE:				
Wendte	VIw-1	Clayey Overflow	4	NS
Sansarc	VIIe-8	Shallow Clay	10	NS

INTERPRETIVE GROUPS--Continued

Map symbol and soil name	Land capability unit	Range site	Windbreak suitability group	Pasture suitability group
Ww:				
Wortman-----------	IVs-2	Claypan------------	9	C
Wanblee-----------	VIs-1	Thin Claypan-------	10	NS

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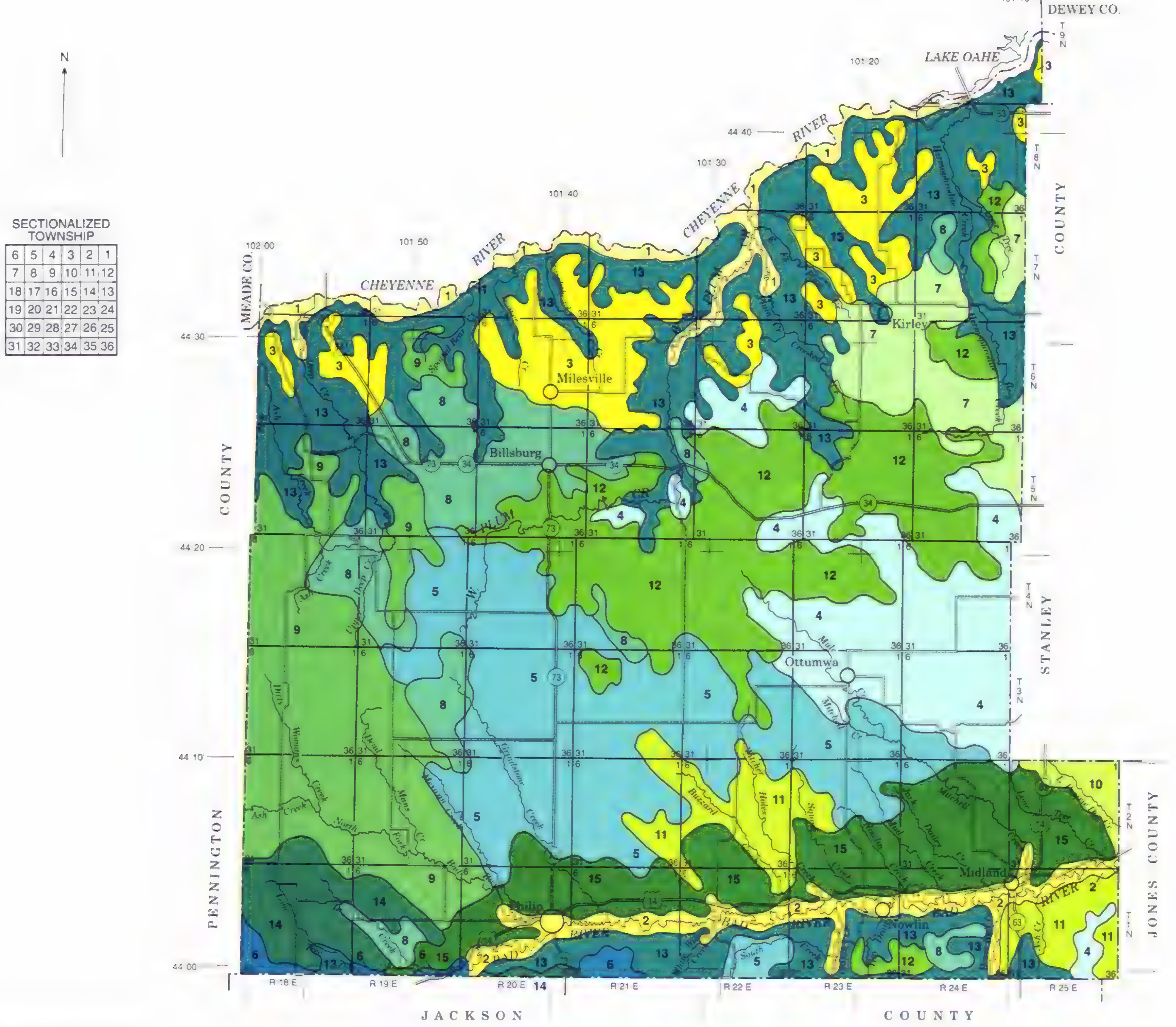
NRCS Accessibility Statement



Each area outlined on this map consist of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts

SOIL LEGEND*

NEARLY LEVEL AND GENTLY UNDULATING, SANDY, LOAMY, AND CLAYEY SOILS ON FLOOD PLAINS

1 Bankard-Craft-Wendte association

2 Nimbro association

NEARLY LEVEL TO MODERATELY SLOPING, LOAMY SOILS ON TERRACES

3 Ree association

NEARLY LEVEL TO STRONGLY SLOPING, CLAYEY SOILS ON UNDISSECTED AND DISSECTED PLAINS

4 Ottumwa-Lakoma-Kolls association

5 Ottumwa-Lakoma association

6 Pierre-Kyle association

7 Promise-Opal-Ottumwa association

NEARLY LEVEL TO STEEP, CLAYEY AND LOAMY SOILS ON UNDISSECTED AND DISSECTED PLAINS AND ON TERRACES

8 Ottumwa-Kirley association

9 Ottumwa-Razor-Midway association

MODERATELY SLOPING TO STEEP, CLAYEY SOILS ON DISSECTED PLAINS

10 Okaton-Lakoma association

11 Lakoma-Okaton association

12 Pierre-Samsil association

13 Samsil-Pierre association

NEARLY LEVEL TO VERY STEEP, LOAMY AND CLAYEY SOILS ON UNDISSECTED AND DISSECTED PLAINS AND ON TERRACES

14 Midway-Razor-Blackpipe association

15 Kirley-Lakoma-Vivian association

*The units on this legend are described in the text under the heading "General Soil Map Units."

Compiled 1996

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

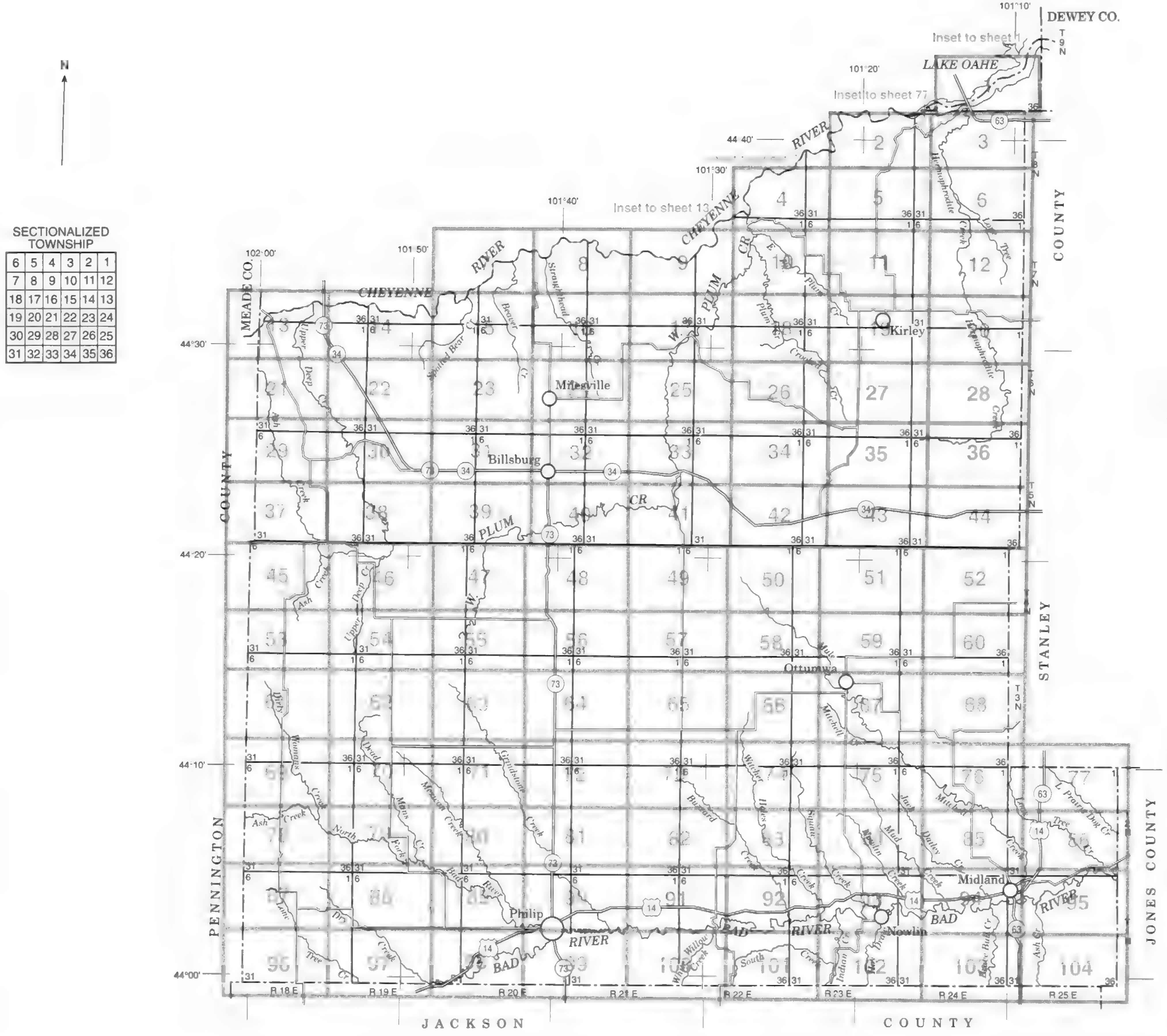
GENERAL SOIL MAP

HAKOON COUNTY, SOUTH DAKOTA

Scale 1:380 160

1 0 1 2 3 4 5 6 Miles

1 0 6 12 Km



Original text from each individual map sheet read:
This map is compiled on 1976 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

INDEX TO MAP SHEETS

HAAKON COUNTY, SOUTH DAKOTA

Scale 1:380,160

SOIL LEGEND

Map symbols consist of a combination of letters. The first capital letter is the initial one of the map unit name. The lowercase letter that follows separates map units having names that begin with the same letter, except that it does not separate sloping phases. The second capital letter indicates the slope class. Symbols without a slope letter are for level or nearly level soils, or map units classified at higher taxonomic levels.

SYMBOL	NAME
Ab	Albaton silty clay, depressional
Ar	Arvada silt loam
As	Arvada-Slickspots complex
Bc	Bankard loamy sand, hummocky
Bd	Bankard very fine sandy loam
BkA	Blackpipe silty clay loam, 0 to 2 percent slopes
BkB	Blackpipe silty clay loam, 2 to 6 percent slopes
Bo	Blackpipe-Wortman complex
Bu	Bullcreek clay, 0 to 6 percent slopes
Bx	Bullcreek-Slickspots complex
Ca	Canning loam
CbA	Capa silt loam, 0 to 6 percent slopes
Cc	Capa-Slickspots complex
Ct	Capa-Wendte, channeled, complex
Cv	Craft very fine sandy loam
Eg	Egas silty clay loam
Ha	Haverson silt loam
Hb	Haverson silt loam, channeled
Hc	Haverson-Craft complex
Ho	Hilmoe silty clay
HpB	Hisle silt loam, 0 to 6 percent slopes
Hv	Hoven silt loam
KeA	Kirley clay loam, 0 to 2 percent slopes
KeB	Kirley clay loam, 2 to 6 percent slopes
KeD	Kirley clay loam, 6 to 15 percent slopes
KfB	Kirley-Canning complex, 2 to 6 percent slopes
KhA	Kirley-Mosher complex, 0 to 2 percent slopes
KhB	Kirley-Mosher complex, 2 to 6 percent slopes
KmA	Kirley-Ottumwa complex, 0 to 2 percent slopes
KmB	Kirley-Ottumwa complex, 2 to 6 percent slopes
KmC	Kirley-Ottumwa complex, 6 to 9 percent slopes
KnD	Kirley-Vivian complex, 6 to 15 percent slopes
Ko	Kolls clay
KyA	Kyle clay, 0 to 3 percent slopes
KyB	Kyle clay, 3 to 6 percent slopes
LaB	Lakoma silty clay, 3 to 6 percent slopes
LaC	Lakoma silty clay, 6 to 9 percent slopes
LaD	Lakoma silty clay, 6 to 15 percent slopes
LbE	Lakoma-Vivian complex, 9 to 25 percent slopes
Lo	Lohmiller silty clay
Lp	Lohmiller silty clay, channeled
Lv	Lohmiller-Arvada complex
MaE	Midway silty clay loam, 15 to 40 percent slopes
Mo	Mosher silt loam
Nb	Nimbro silty clay loam
Nc	Nimbro silty clay loam, channeled
NuA	Nunn loam, 0 to 2 percent slopes
NuB	Nunn loam, 2 to 6 percent slopes
NuC	Nunn loam, 6 to 9 percent slopes
NxD	Nunn-Nihill complex, 6 to 15 percent slopes

SYMBOL	NAME
ObE	Okaton-Lakoma silty clays, 15 to 40 percent slopes
Oc	Onita silt loam
OdB	Opal clay, 3 to 6 percent slopes
OdC	Opal clay, 6 to 9 percent slopes
OdD	Opal clay, 6 to 15 percent slopes
OeB	Opal-Promise clays, 3 to 6 percent slopes
OeC	Opal-Promise clays, 6 to 9 percent slopes
Of	Orthents, clayey
Og	Orthents, gravelly
OtA	Ottumwa silty clay, 0 to 3 percent slopes
OtB	Ottumwa silty clay, 3 to 6 percent slopes
OvA	Ottumwa-Capa complex, 0 to 3 percent slopes
OwB	Ottumwa-Lakoma silty clays, 3 to 6 percent slopes
OwC	Ottumwa-Lakoma silty clays, 6 to 9 percent slopes
OxC	Ottumwa-Razor silty clays, 6 to 9 percent slopes
OyC	Ottumwa-Razor-Savo complex, 6 to 15 percent slopes
PeC	Pierre clay, 6 to 9 percent slopes
PeD	Pierre clay, 6 to 15 percent slopes
PkE	Pierre-Samsil clays, 15 to 25 percent slopes
PrA	Promise clay, 0 to 3 percent slopes
PrB	Promise clay, 3 to 6 percent slopes
RaB	Razor silty clay, 2 to 6 percent slopes
RaC	Razor silty clay, 6 to 9 percent slopes
RbD	Razor-Midway complex, 6 to 15 percent slopes
RdD	Razor-Shingle complex, 6 to 15 percent slopes
ReA	Ree loam, 0 to 2 percent slopes
ReB	Ree loam, 2 to 6 percent slopes
RfB	Ree-Canning loams, 2 to 6 percent slopes
RfC	Ree-Canning loams, 6 to 9 percent slopes
Rh	Ree-Hoven complex
RkD	Ree-Vivian complex, 6 to 15 percent slopes
Rv	Riverwash
SbF	Samsil clay, 25 to 60 percent slopes
ScF	Samsil-Nihill complex, 6 to 40 percent slopes
SdF	Samsil-Rock outcrop complex, 15 to 60 percent slopes
SoE	Sansarc-Opal clays, 9 to 40 percent slopes
SrA	Savo silt loam, 0 to 2 percent slopes
SrB	Savo silt loam, 2 to 6 percent slopes
SrC	Savo silt loam, 6 to 9 percent slopes
StF	Schamber-Samsil complex, 6 to 60 percent slopes
SuE	Shingle silty clay loam, 15 to 40 percent slopes
SwE	Shingle-Razor complex, 15 to 25 percent slopes
Wc	Wendte silty clay
Wd	Wendte-Herdcamp silty clays, channeled
WsE	Wendte, channeled-Sansarc complex, 0 to 60 percent slopes
Ww	Wortman-Wanblee silt loams, 0 to 2 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state, or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline and neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK
1 890 000 FEET

LAND DIVISION CORNER (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate 56
- Federal 287
- State 52
- County, farm or ranch 1283

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or Small (Named where applicable)

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban area) (occupied)
- Church
- School
- Indian mound (label)
- Located object (label) Tower
- Tank (label) Gas
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS Ab KhA

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

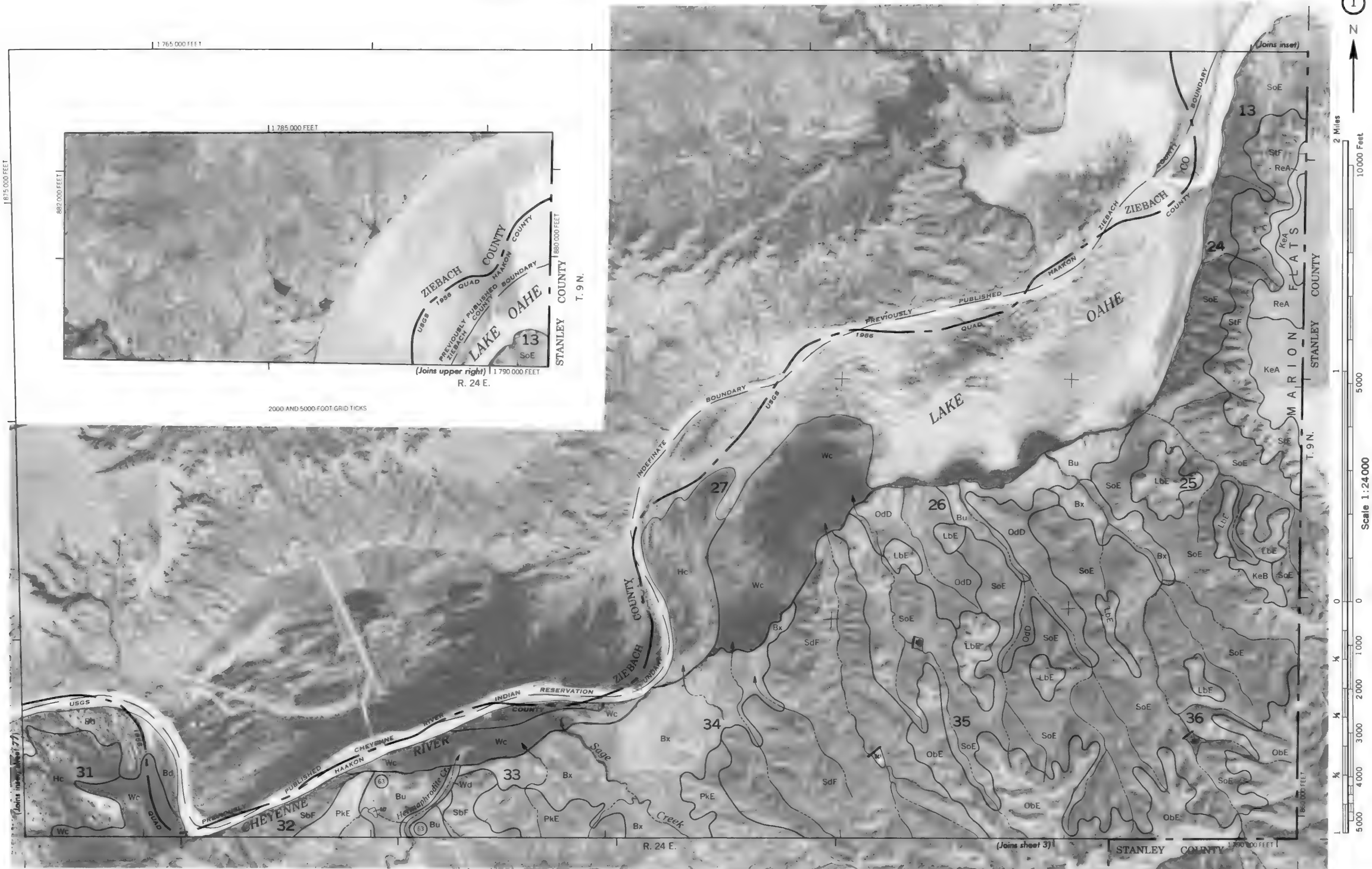
GULLY

DEPRESSION OR SINK

SOIL SAMPLE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot


1
N
LAKE OAHE
ZIEBACH COUNTY
HAAKON COUNTY
STANLEY COUNTY
USGS 1956 QUAD
PREVIOUSLY PUBLISHED ZIEBACH COUNTY BOUNDARY
PREVIOUSLY PUBLISHED HAAKON COUNTY BOUNDARY
INDEFINATE BOUNDARY
CHEYENNE RIVER INDIAN RESERVATION
CHEYENNE RIVER
MARION FLATS
Sage Creek
Hermaphrodite Cr.
T. 9 N.
R. 24 E.
(Joins upper right)
(Joins inset)
(Joins sheet 3)
2000 AND 5000-FOOT GRID TICKS
1 765 000 FEET
1 785 000 FEET
1 790 000 FEET
875 000 FEET
882 000 FEET
880 000 FEET
860 000 FEET
Scale 1:24000
2 Miles
1
0
10000 Feet
5000
1000
2000
3000
4000
13
24
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26
27
31
32
33
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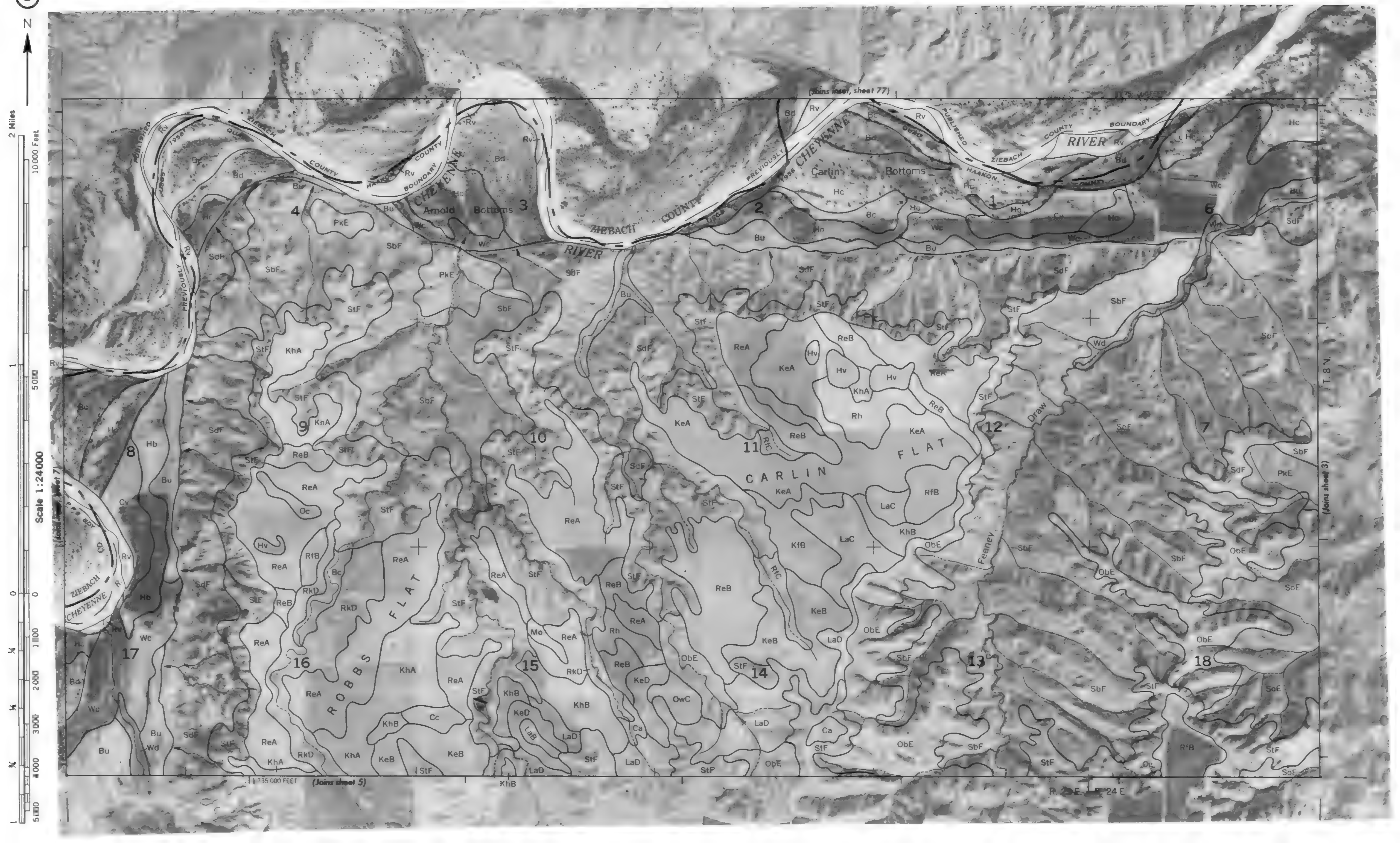
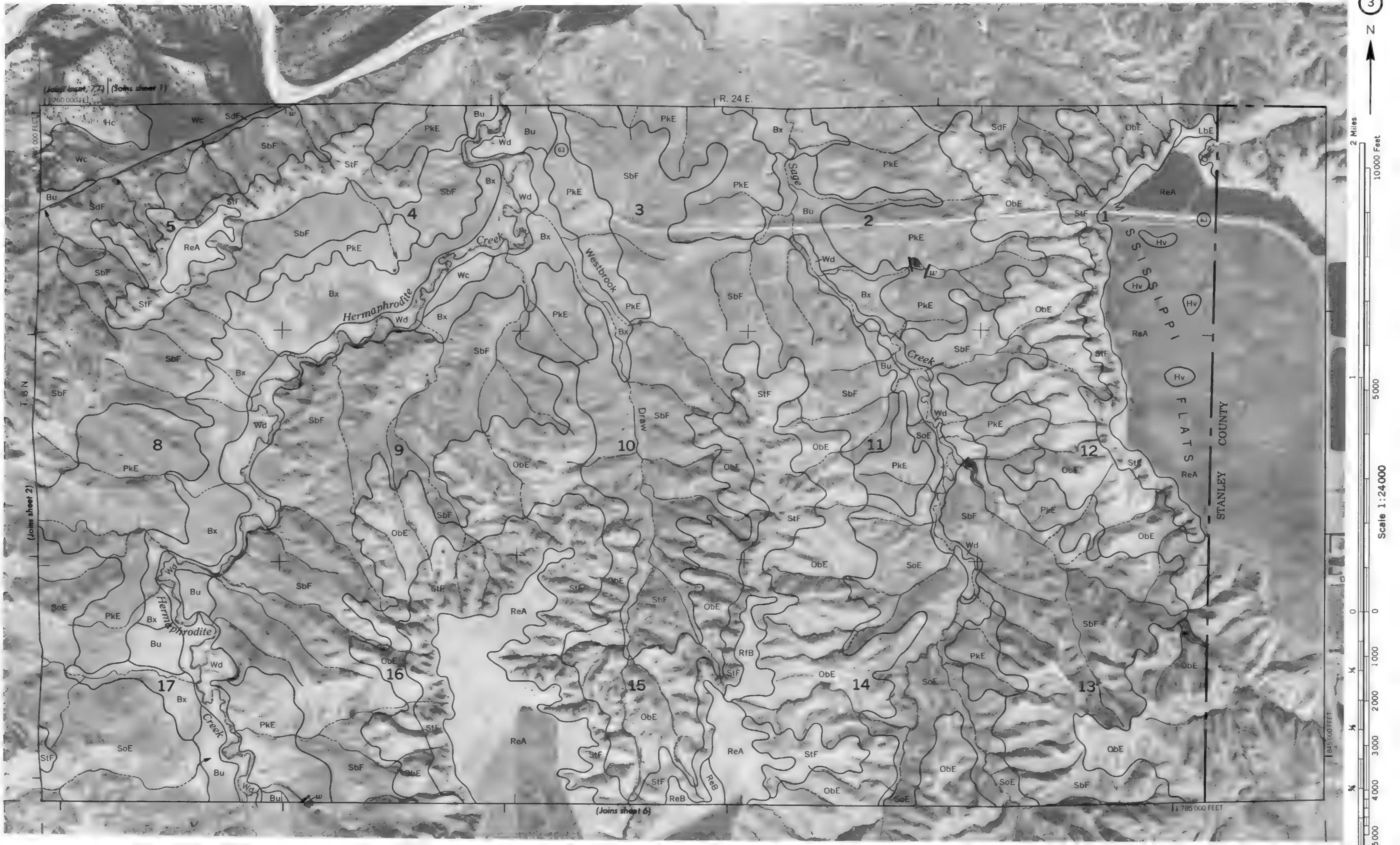
36
SoE
StF
ReA
KeA
KeA
KeB
LbE
Bu
Bx
OdD
Wc
Hc
SdF
ObE
PkE
SbF
Bd
Wd
63

(2)


N
Scale 1:24000
2 Miles
10 000 Feet
(Joins inset, sheet 77)
(Joins sheet 7)
(Joins sheet 3)
(Joins sheet 5)
735 000 FEET
T. 8 N.
R. 23 E. | R. 24 E.
CHEYENNE RIVER
ZIEBACH COUNTY
HAAKON COUNTY BOUNDARY
PREVIOUSLY PUBLISHED
Arnold Bottoms
Carlin Bottoms
CARLIN FLAT
ROBBS FLAT
Feeney Draw
ZIEBACH CO.
CHEYENNE R.


3
N
(Joins inset, 7.7)
(Joins sheet 1)
R. 24 E.
T. 3 N.
(Joins sheet 2)
(Joins sheet 6)
1 785 000 FEET
STANLEY COUNTY
MISSISSIPPI FLATS
Hermaphrodite Creek
Westbrook Draw
Sage Creek
2 Miles
1
0
10000 Feet
5000
0
Scale 1:24000
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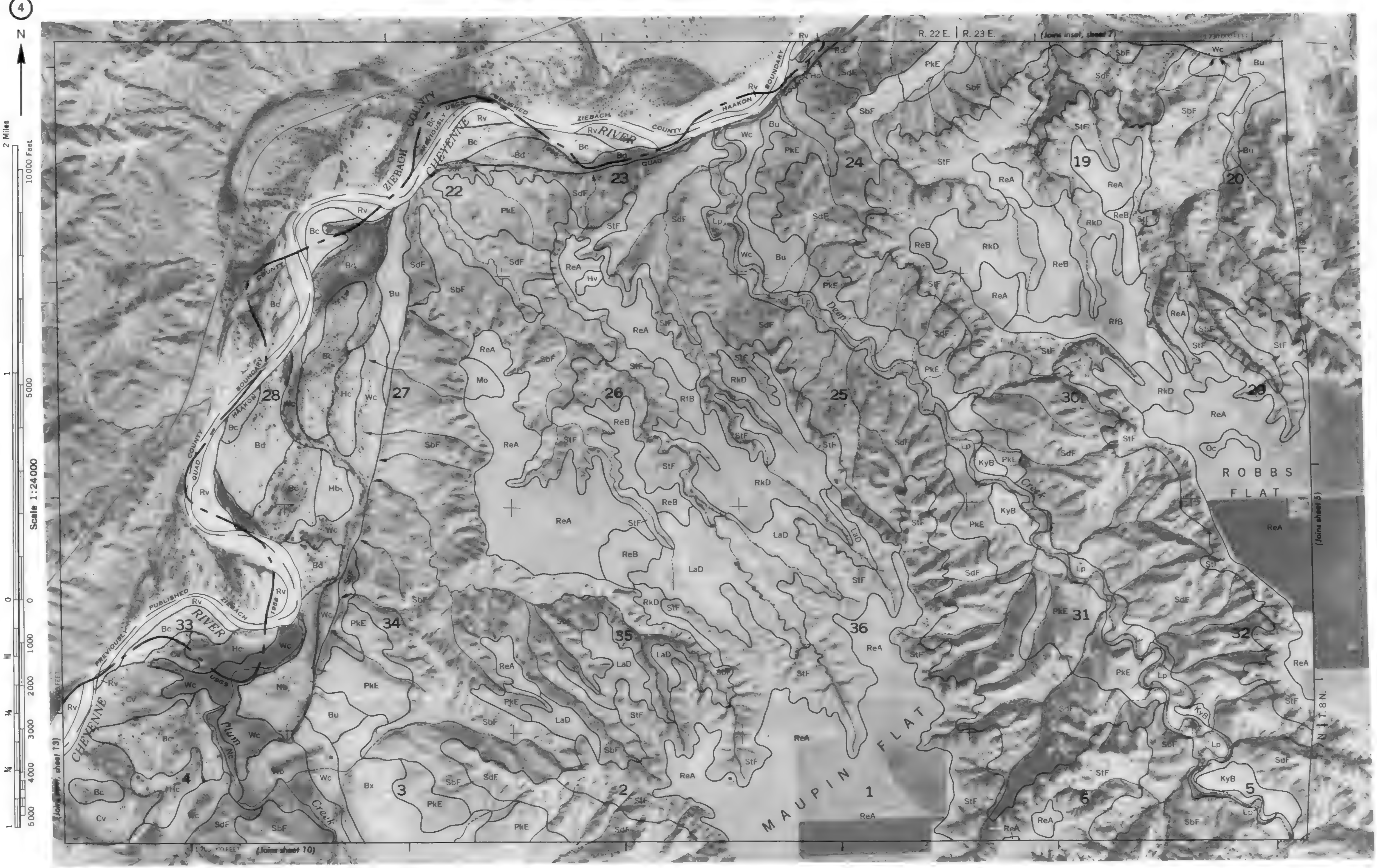
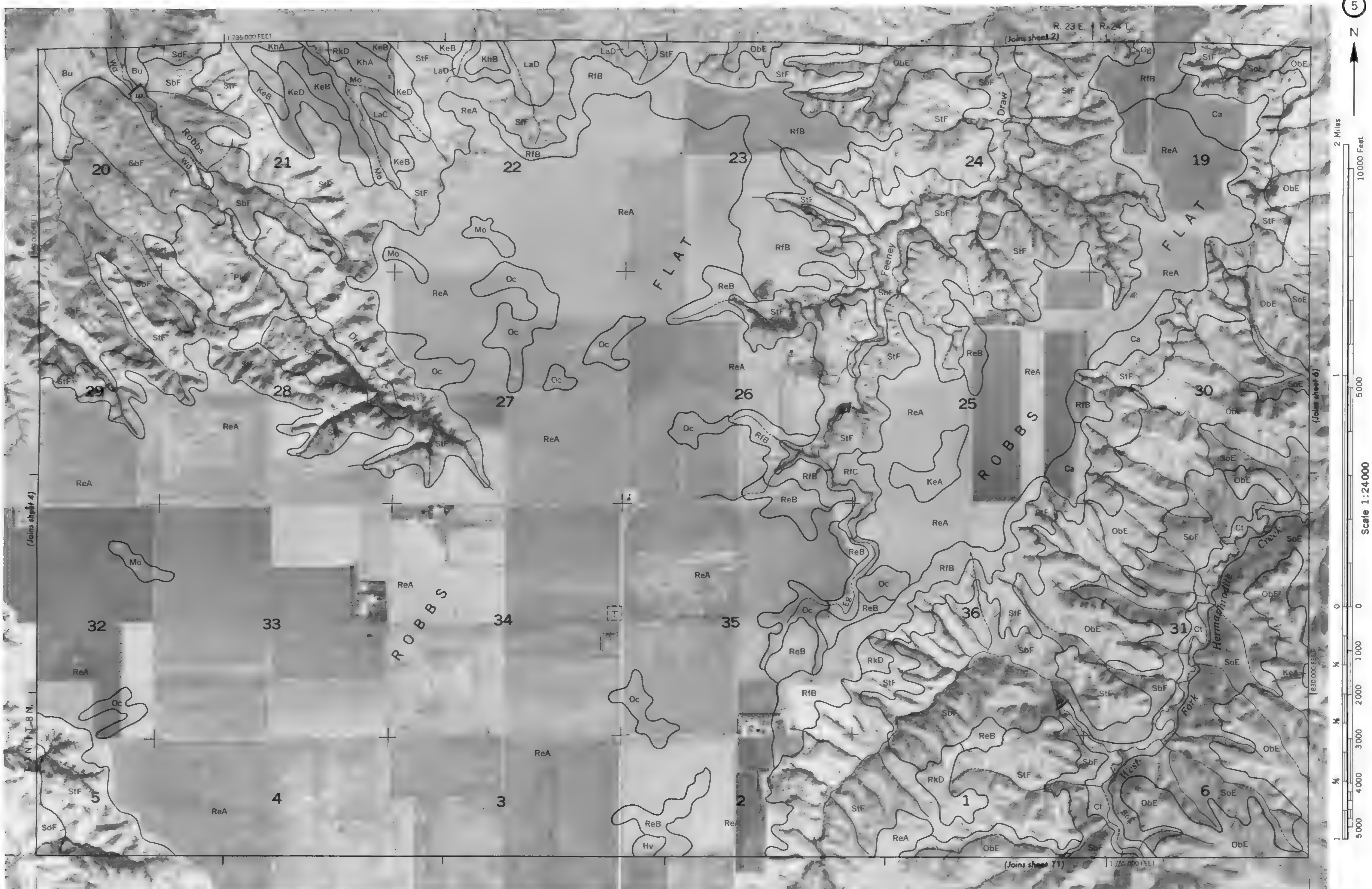
11
12
13
14
15
16
17
Bu
Bx
Hc
Hv
LbE
ObE
PkE
ReA
ReB
RfB
SbF
SdF
SoE
StF
Wc
Wd
63

HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 4




5
N
(Joins sheet 2)
R. 23 E. R. 24 E.
(Joins sheet 4)
(Joins sheet 6)
(Joins sheet 11)
T. 1 N.
1 735 000 FEET
1 755 000 FEET
830 000 FEET
ROBBS FLAT
ROBBS FLAT
ROBBS
Robbs Draw
Feeney Draw
Hermaphrodite Creek
West Fork
Scale 1:24 000
2 Miles
10 000 Feet
1
5000
0
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1000
2000
3000
4000
5000
19
20
21
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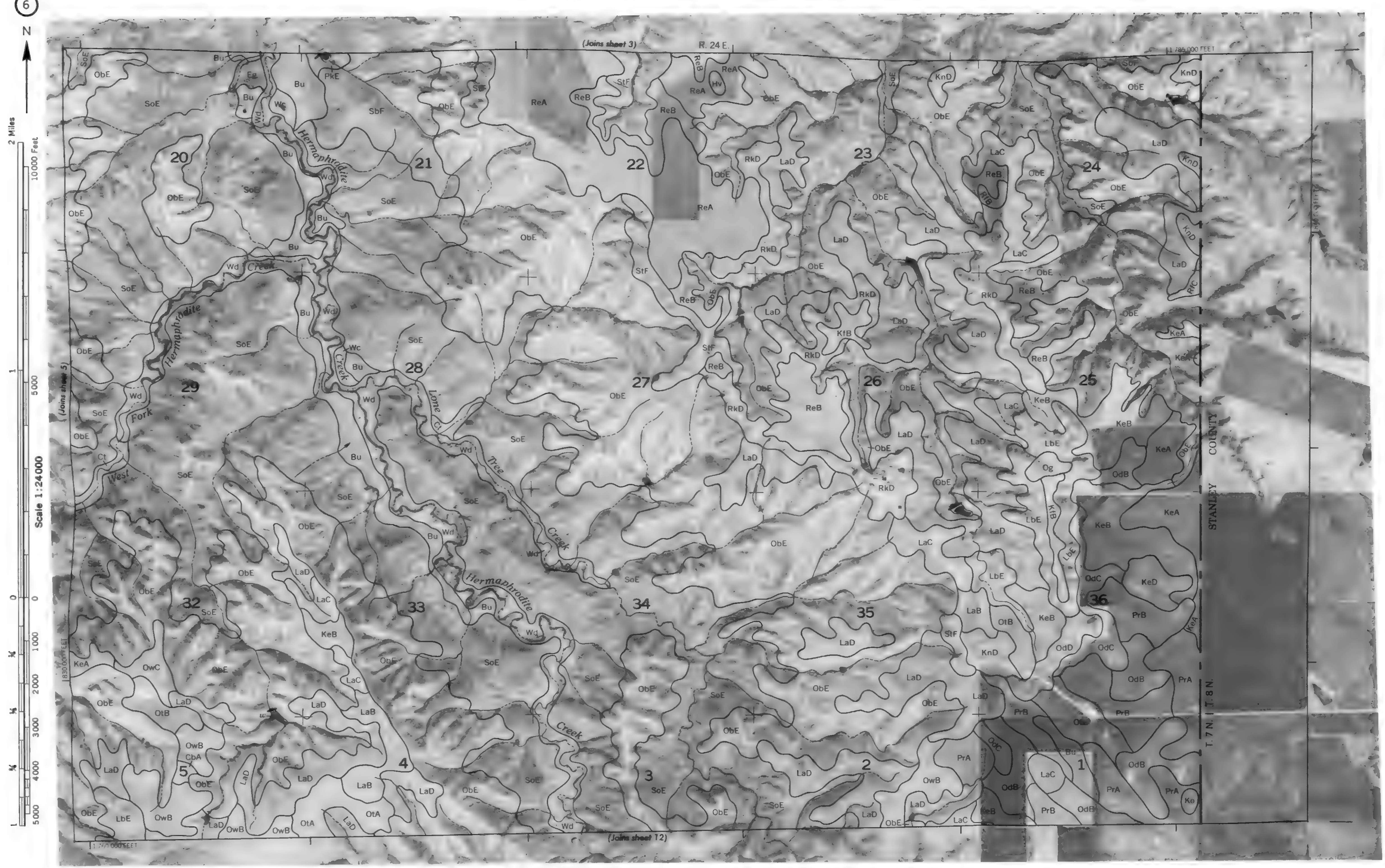
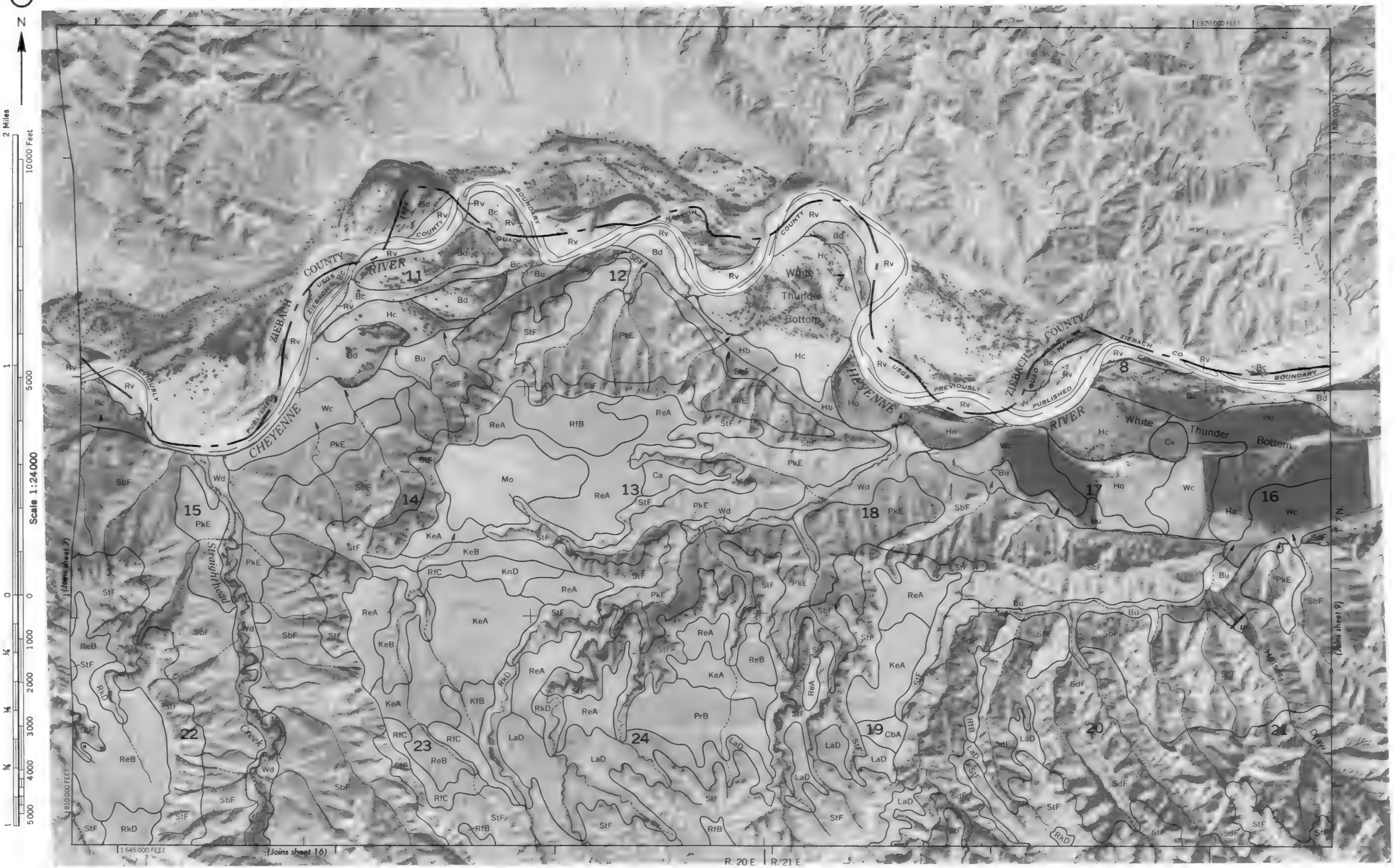
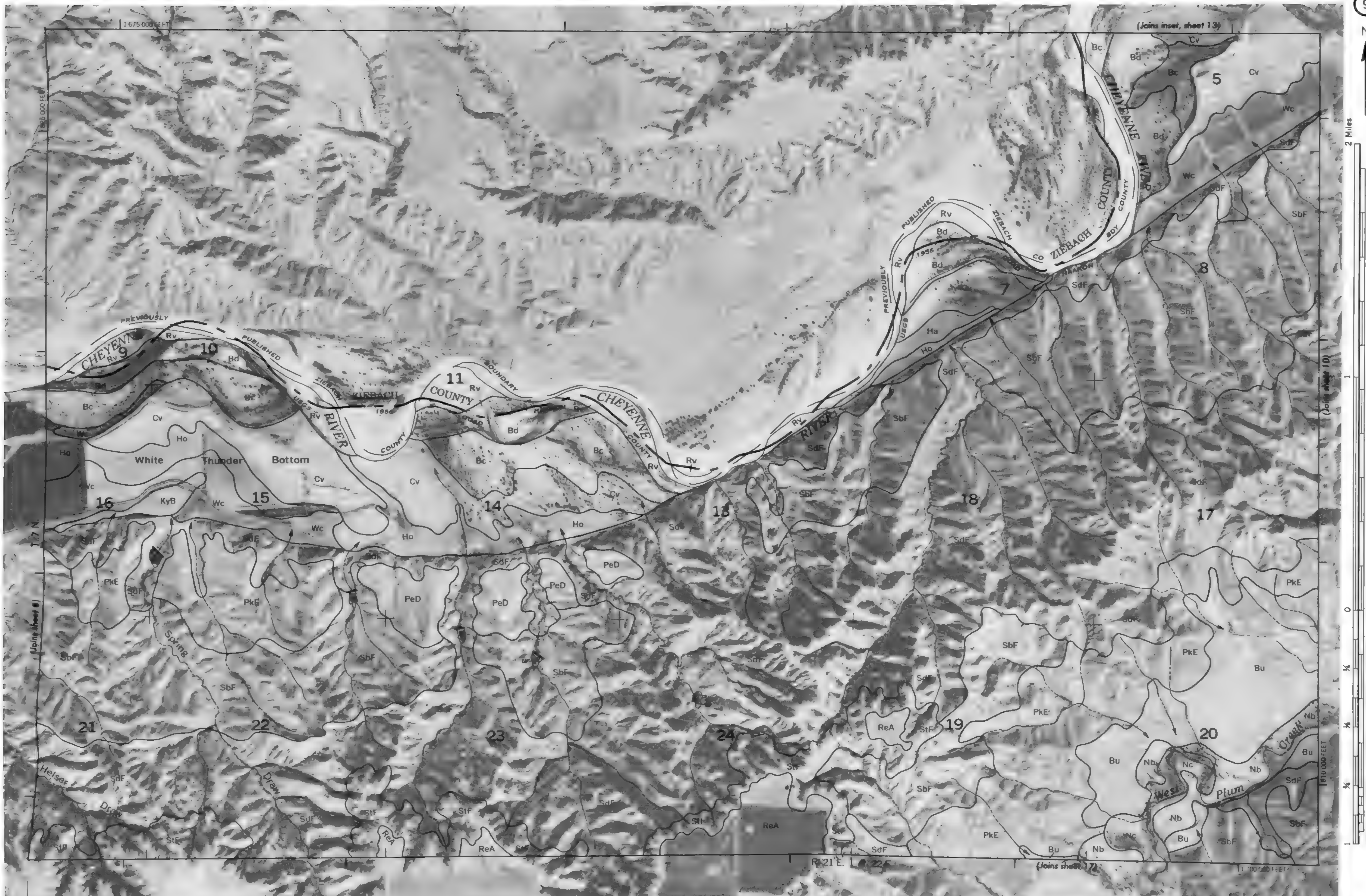
HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 6




7
N
1 620 000 FEET
1 720 000 FEET
825 000 FEET
855 000 FEET
845 000 FEET
1 730 000 FEET
(Joins sheet 4)
(Joins sheet 2)
(Joins sheet 8)
(Joins sheet 15)
R. 22 E. | R. 23 E.
R. 19 E. | R. 20 E.
T. 8 N.
T. 7 N.
CHEYENNE
RIVER
ZIEBACH
COUNTY
HAAKON
CO. BOUNDARY
COUNTY BOUNDARY
USGS QUAD
PREVIOUSLY PUBLISHED
CHEYENNE RIVER INDIAN RESERVATION
Creek
Harding
Scale 1:24 000
2 Miles
1
0
10000 Feet
5000
0
5000
1000
2000
3000
4000
810 000 FEET

HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 8




9
N
(Joins inset, sheet 13)
(Joins sheet 17)
(Joins sheet 8)
(Joins sheet 10)
CHEYENNE RIVER
ZIEBACH COUNTY
HAAKON COUNTY
PREVIOUSLY PUBLISHED USGS 1956 COUNTY BOUNDARY
White Thunder Bottom
Spring
Helser Draw
West Plum Creek
R. 21 E. | R. 22 E.
T. 7 N.
2 Miles
1
0
10 000 Feet
5000
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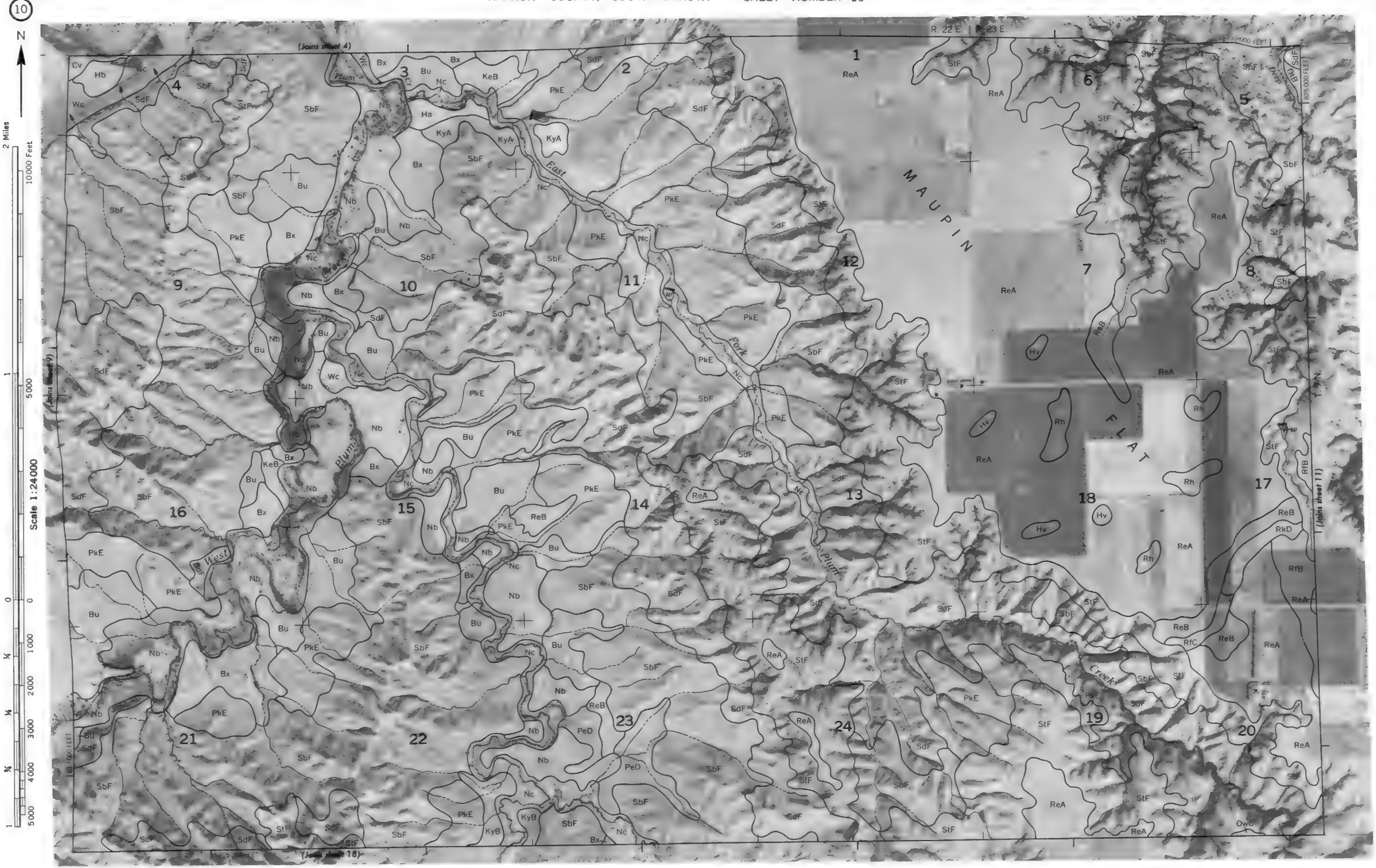
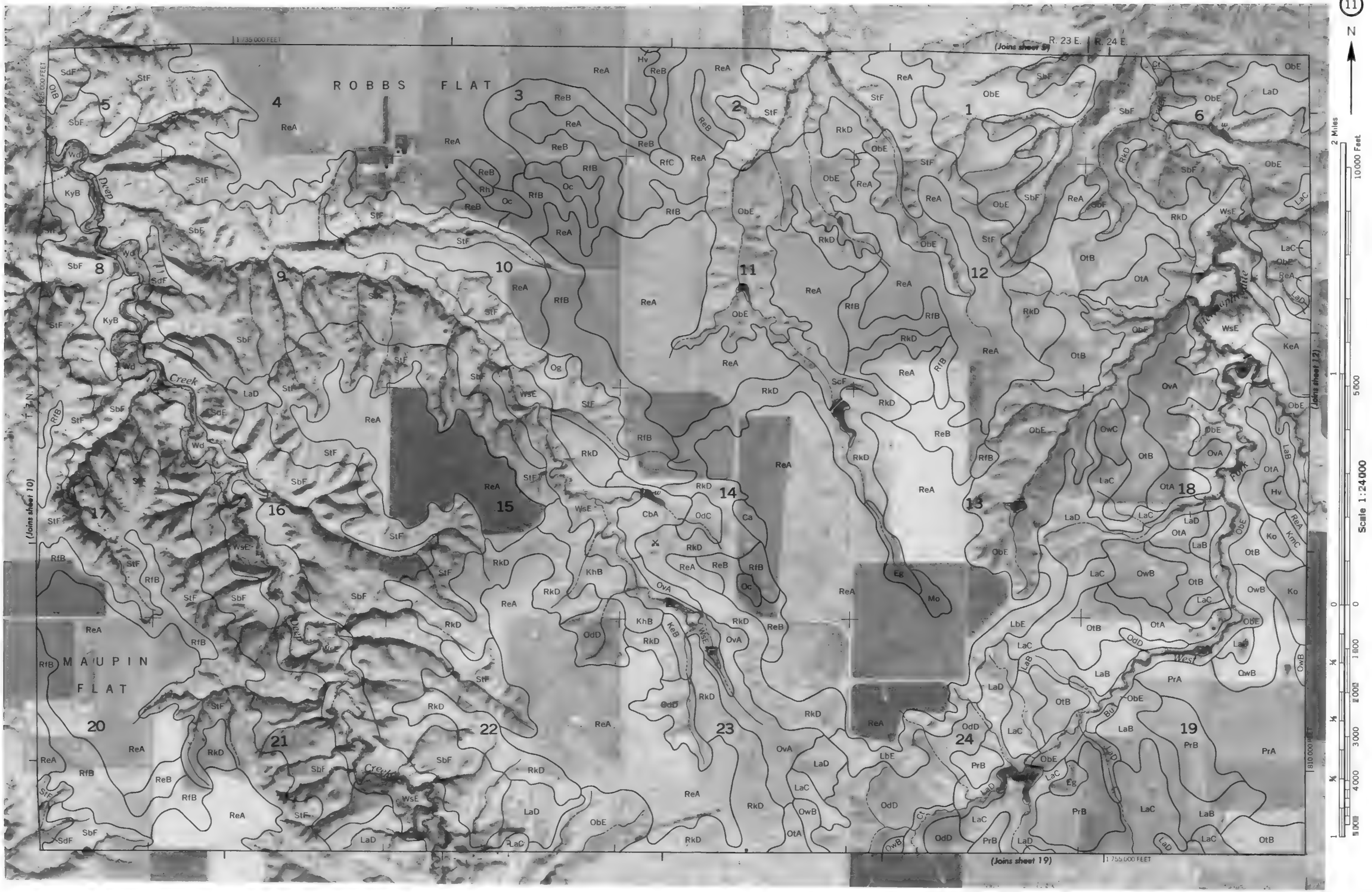
Scale 1:24 000
1 675 000 FEET
1 810 000 FEET
1 700 000 FEET

HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 10




11
N
ROBBS FLAT
MAUPIN FLAT
(Joins sheet 5)
(Joins sheet 10)
(Joins sheet 12)
(Joins sheet 19)
R. 23 E.
R. 24 E.
1 735 000 FEET
1 755 000 FEET
825 000 FEET
810 000 FEET
T. 3 N.
Deep Creek
West Fork
Scale 1:24000
2 Miles
10000 Feet
1
2
3
4
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6
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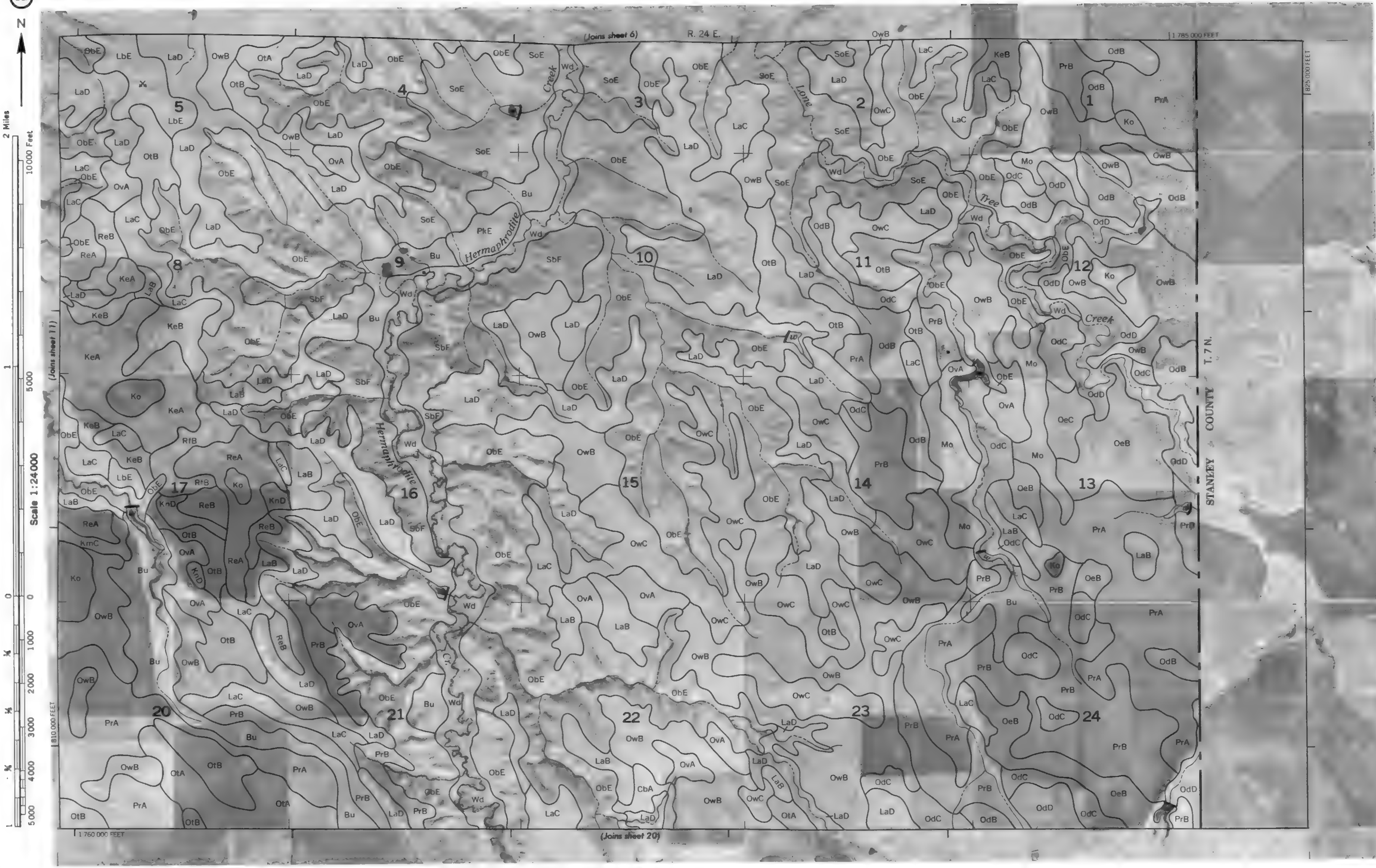
N
2 Miles
10 000 Feet
Scale 1:24 000
(Joins sheet 6)
R. 24 E.
1 785 000 FEET
825 000 FEET
(Joins sheet 11)
(Joins sheet 20)
1 760 000 FEET
810 000 FEET
T. 7 N.
STANLEY COUNTY
Hermaphrodite
Creek
Lone
Tree
Creek
Cr.
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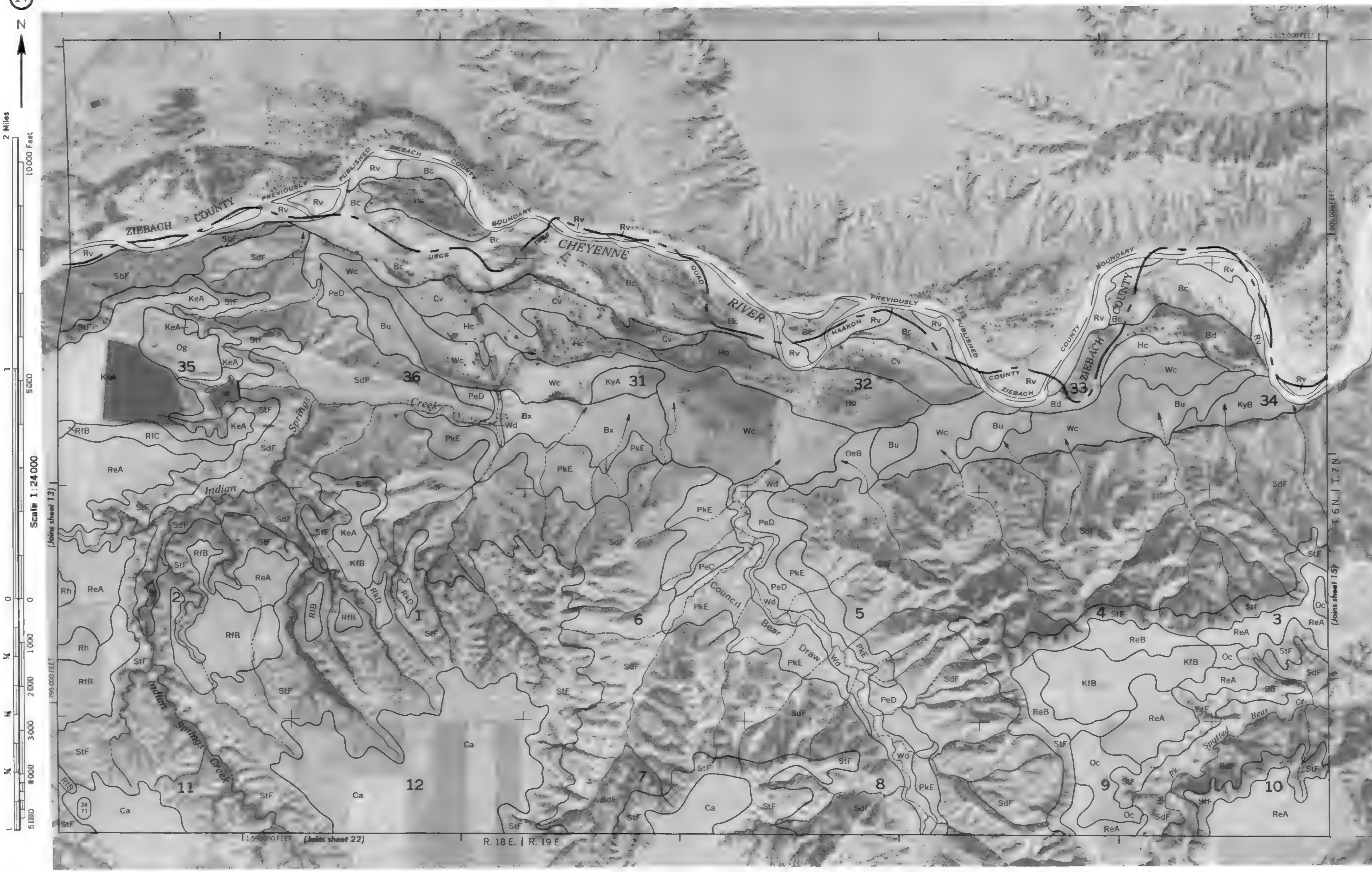
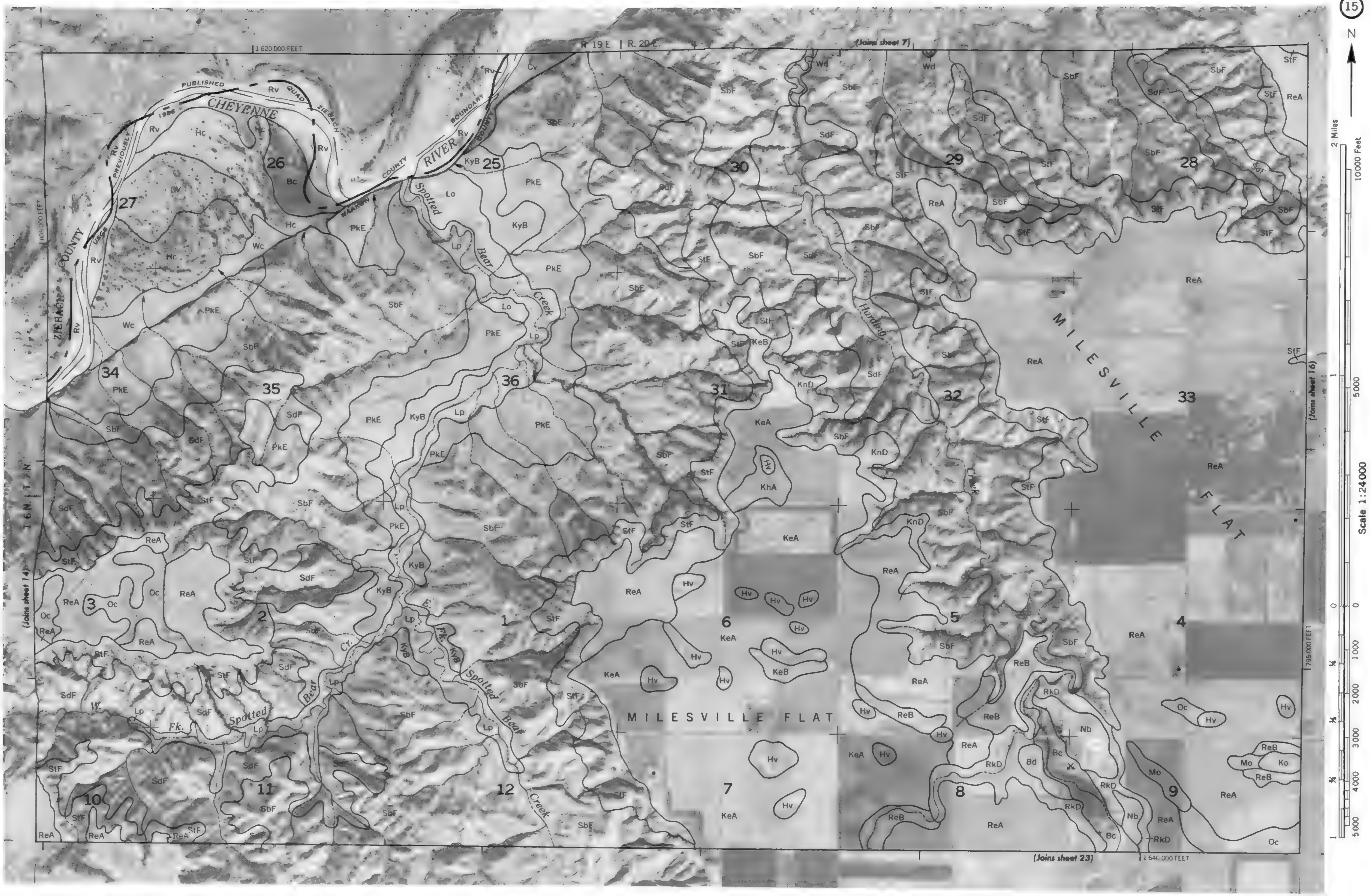
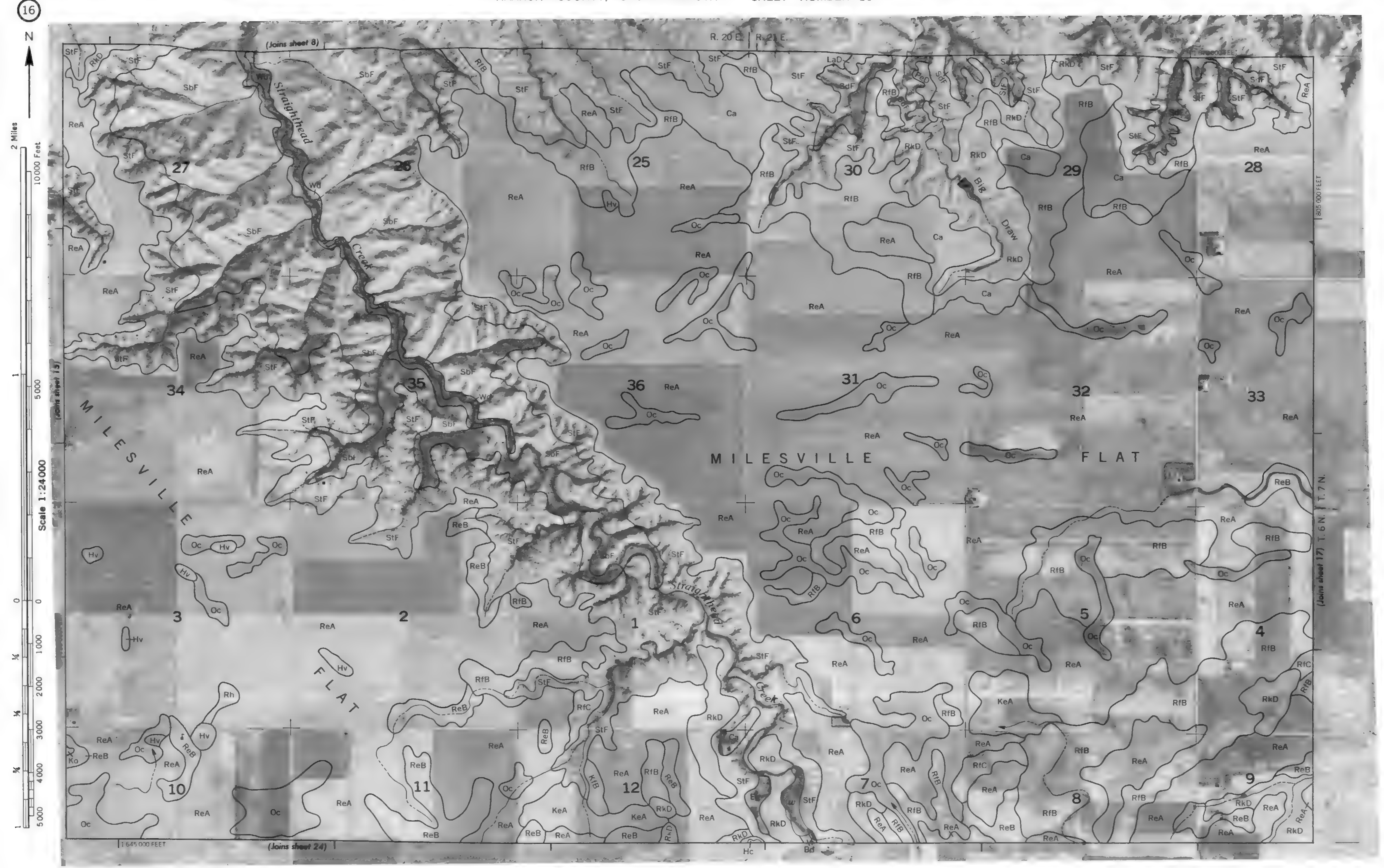
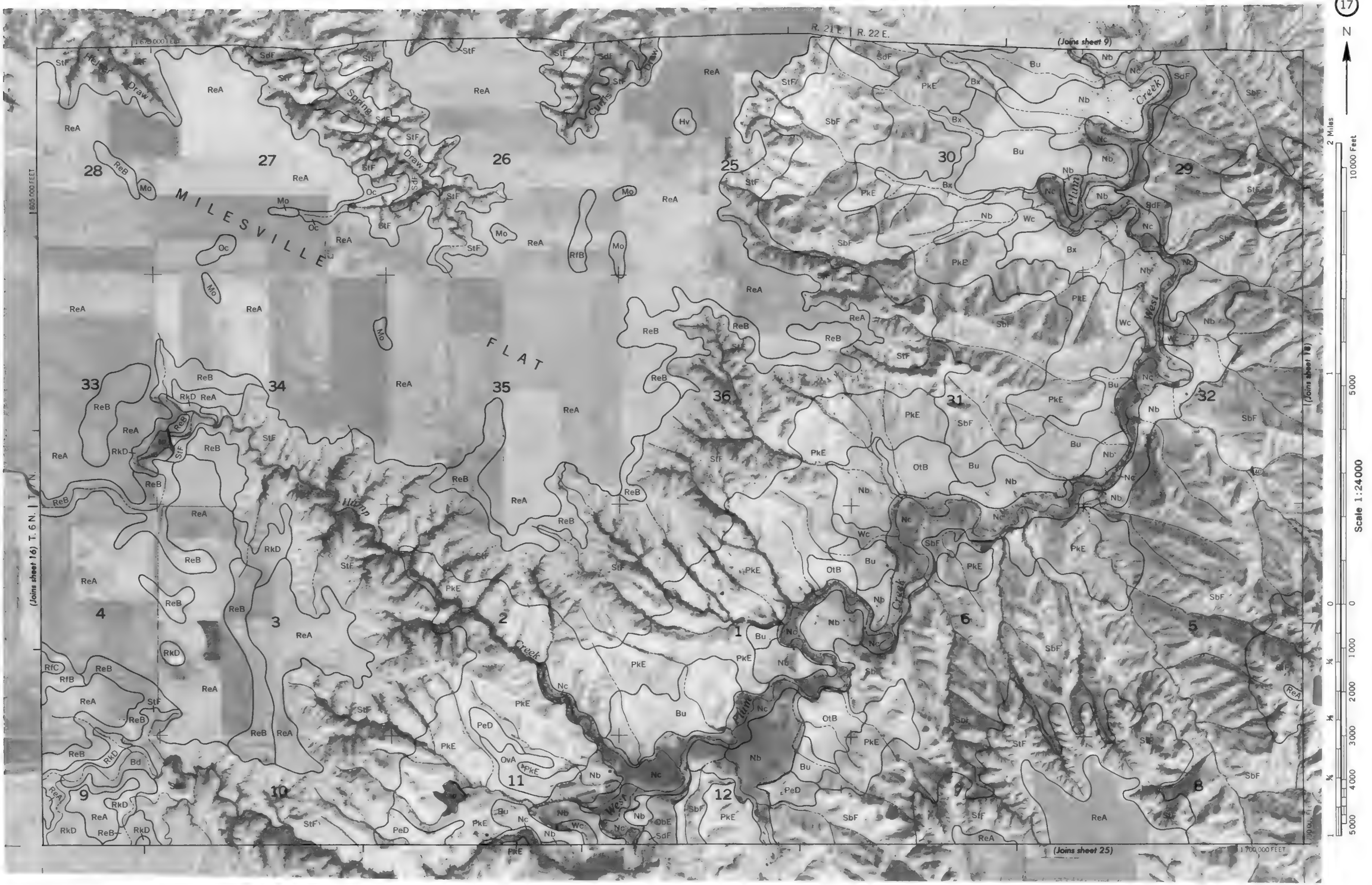
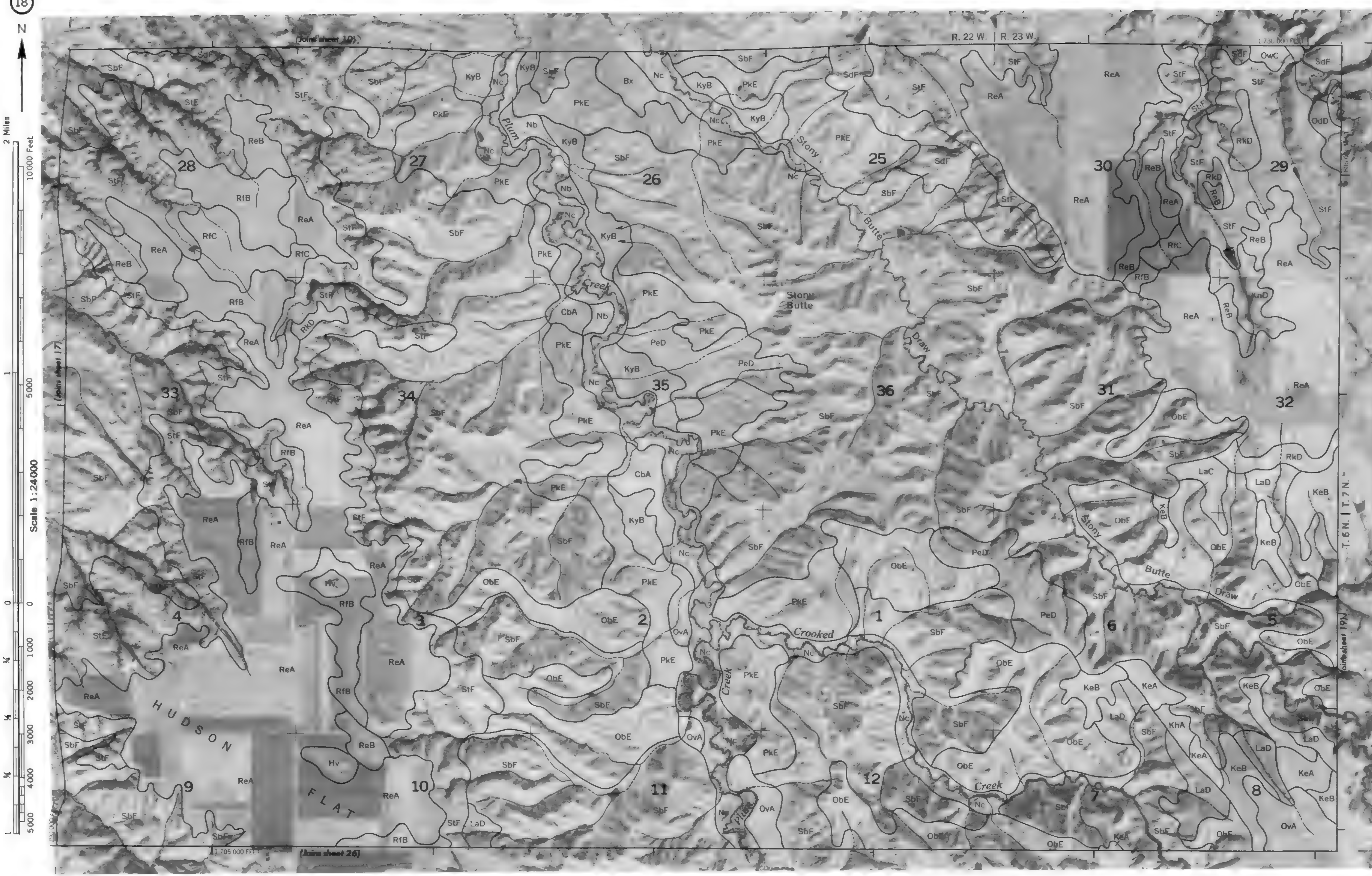
13
N
CHEYENNE RIVER
ZIEBACH COUNTY
HAAKON COUNTY BOUNDARY
PREVIOUSLY PUBLISHED ZIEBACH COUNTY
MEADE COUNTY
PENNINGTON COUNTY
Bridger Creek
Hall Draw
Barthold Flat
R. 22 E.
(Joins sheet 9)
(Joins sheet 4)
(Joins sheet 14)
(Joins sheet 21)
R. 18 E.
T. 7 N.
T. 6 N.
1 560 000 FEET
1 696 000 FEET
1 700 000 FEET
1 585 000 FEET
810 000 FEET
830 000 FEET
827 000 FEET
795 000 FEET
3000 AND 4000-FOOT GRID TICKS
2 Miles
10 000 Feet
Scale 1:24000


14
N
CHEYENNE RIVER
ZIEBACH COUNTY PREVIOUSLY PUBLISHED
ZIEBACH COUNTY PREVIOUSLY PUBLISHED HAAKON COUNTY BOUNDARY
USGS QUAD
Indian Springs Creek
Council Bear Draw
Spotted Bear Cr.
Scale 1:24000
(Joins sheet 13)
(Joins sheet 15)
(Joins sheet 22)
R. 18 E. | R. 19 E.
T. 6 N. | T. 7 N.
1 615 000 FEET
1 590 000 FEET
795 000 FEET
2 Miles
10000 Feet
31
32
33
34
35
36
1
2
3
4
5
6
7
8
9
10
11
12

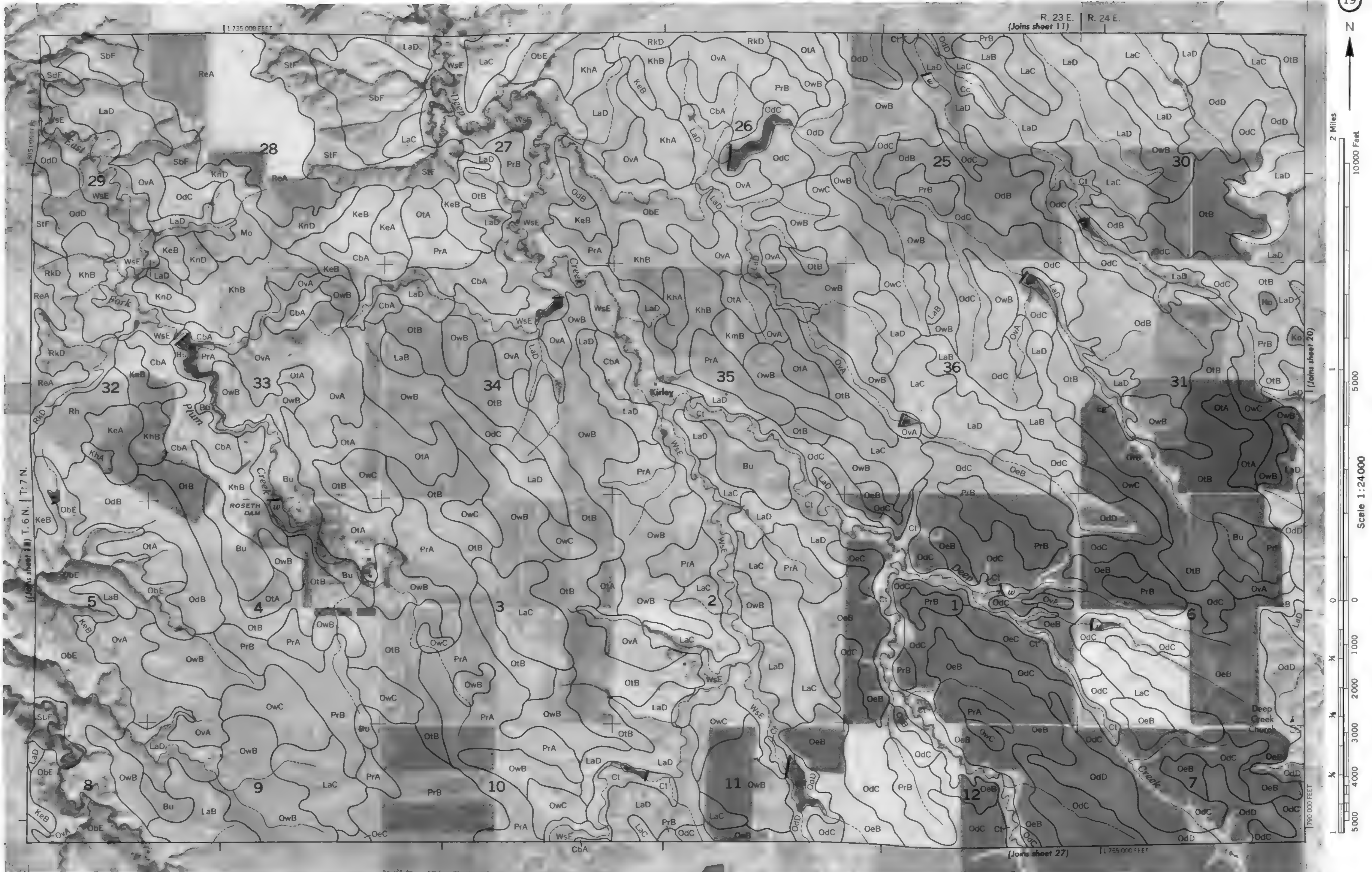

15
N
(Joins sheet 7)
(Joins sheet 16)
(Joins sheet 23)
(Joins sheet 14)
R. 19 E. | R. 20 E.
T. 6 N. | T. 7 N.
1 620 000 FEET
1 640 000 FEET
795 000 FEET
CHEYENNE RIVER
PUBLISHED 1956 QUAD ZIEBACH
PREVIOUSLY USGS
ZIEBACH COUNTY
HAAKON COUNTY BOUNDARY
Spotted Bear Creek
E. Fk. Spotted Bear Cr.
W. Fk. Spotted
Bear Cr.
Harding Creek
MILESVILLE FLAT
MILESVILLE FLAT
2 Miles
10000 Feet
Scale 1:24000


16
N
2 Miles
10 000 Feet
Scale 1:24 000
(Joins sheet 8)
(Joins sheet 15)
(Joins sheet 17)
(Joins sheet 24)
R. 20 E.
R. 21 E.
T. 7 N.
T. 6 N.
1 645 000 FEET
805 000 FEET
Straighthead Creek
Big Draw
MILESVILLE FLAT
MILESVILLE FLAT
27
26
25
30
29
28
34
35
36
31
32
33
3
2
1
6
5
4
10
11
12
7
8
9

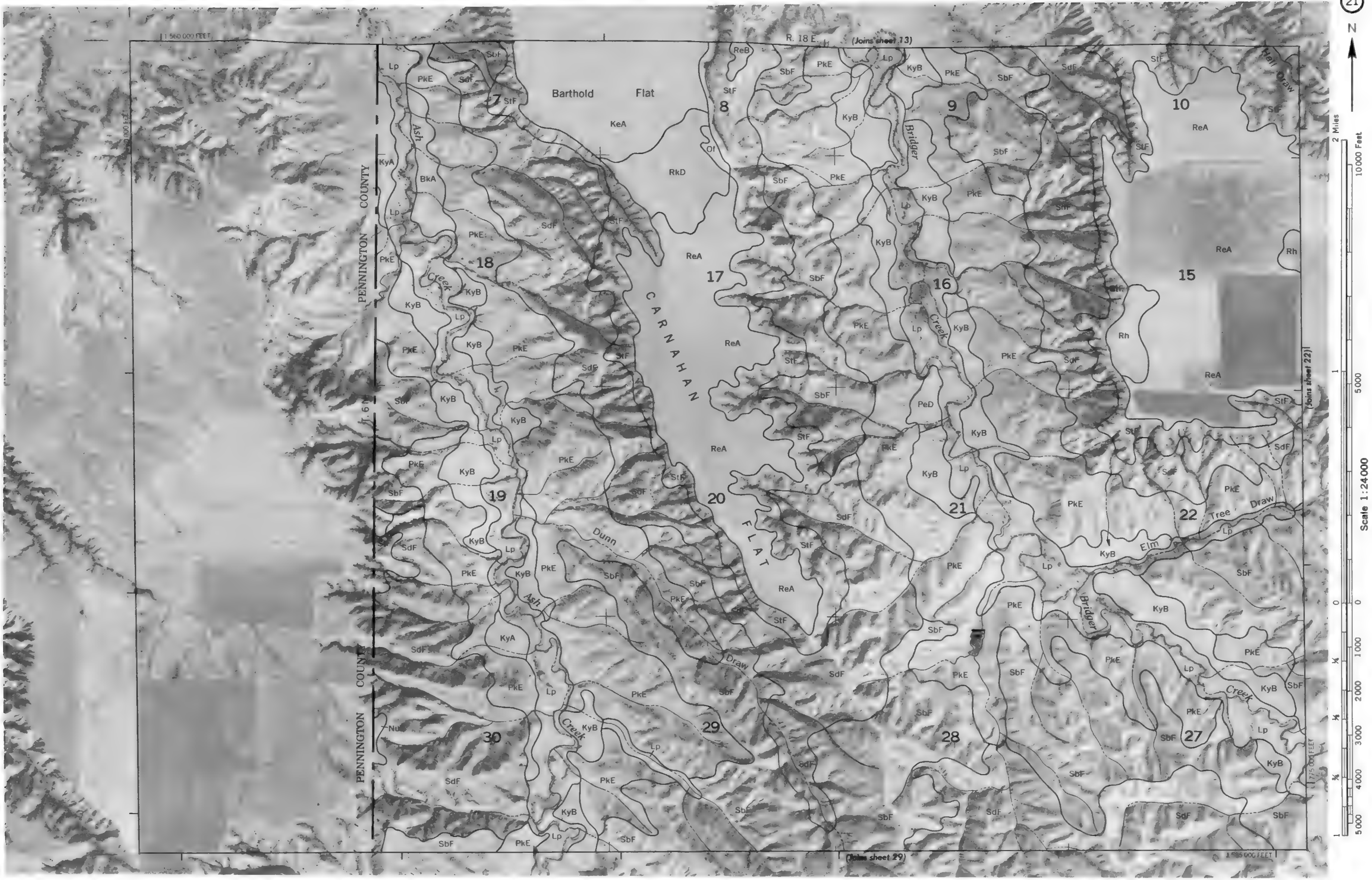

17
N
(Joins sheet 9)
(Joins sheet 16) T. 6 N.
(Joins sheet 18)
(Joins sheet 25)
R. 21 E. | R. 22 E.
MILESVILLE FLAT
Scale 1:24000
2 Miles
10000 Feet
1 700 000 FEET
605 000 FEET


N
2 Miles
10 000 Feet
5000
Scale 1:24 000
(Joins sheet 10)
(Joins sheet 17)
(Joins sheet 19)
(Joins sheet 26)
R. 22 W. | R. 23 W.
T. 6 N. | T. 7 N.
1 730 000 FEET
1 705 000 FEET
Plum Creek
Stony Butte
Stony Butte Draw
Crooked Creek
HUDSON FLAT

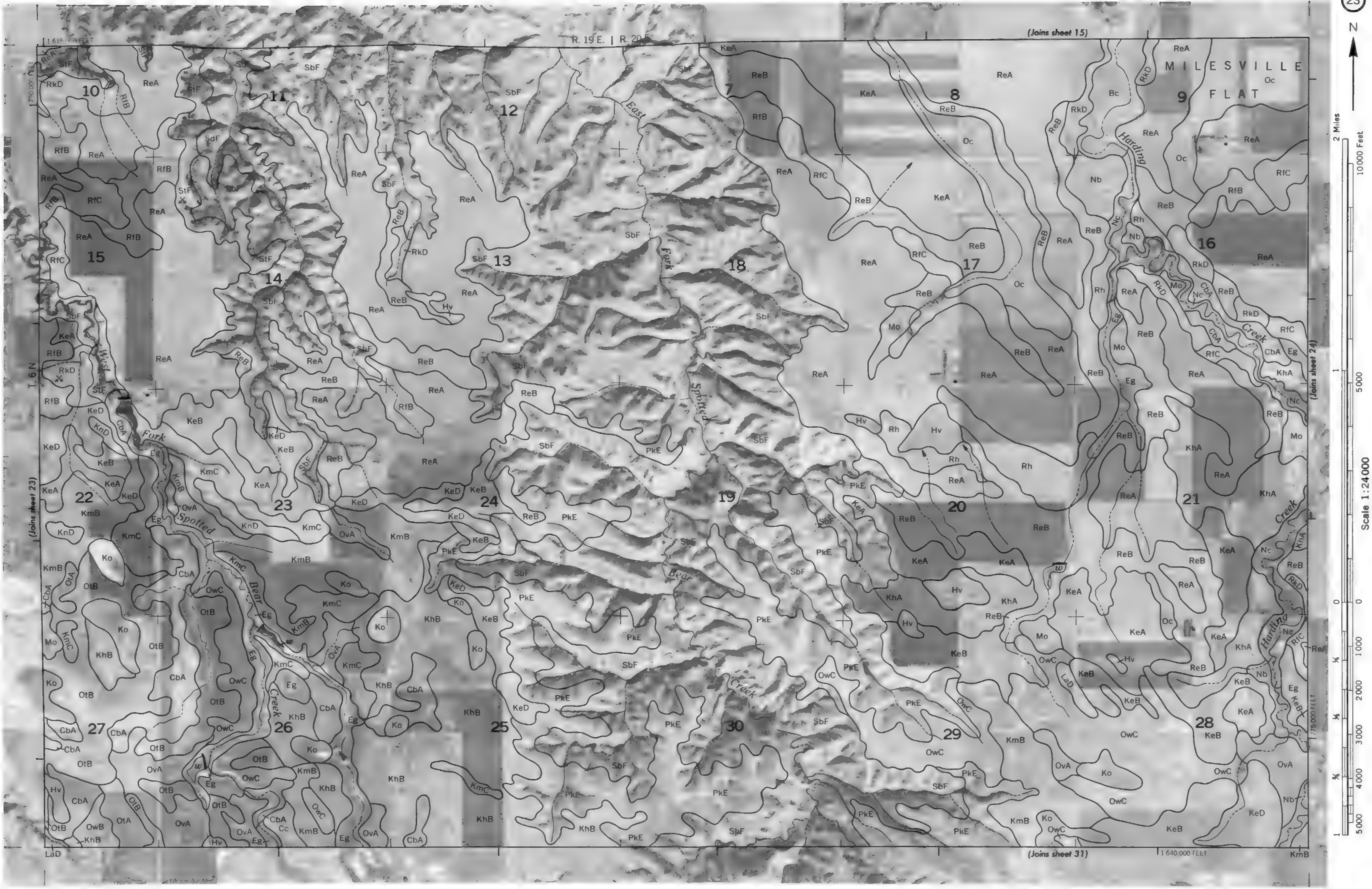
HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 19

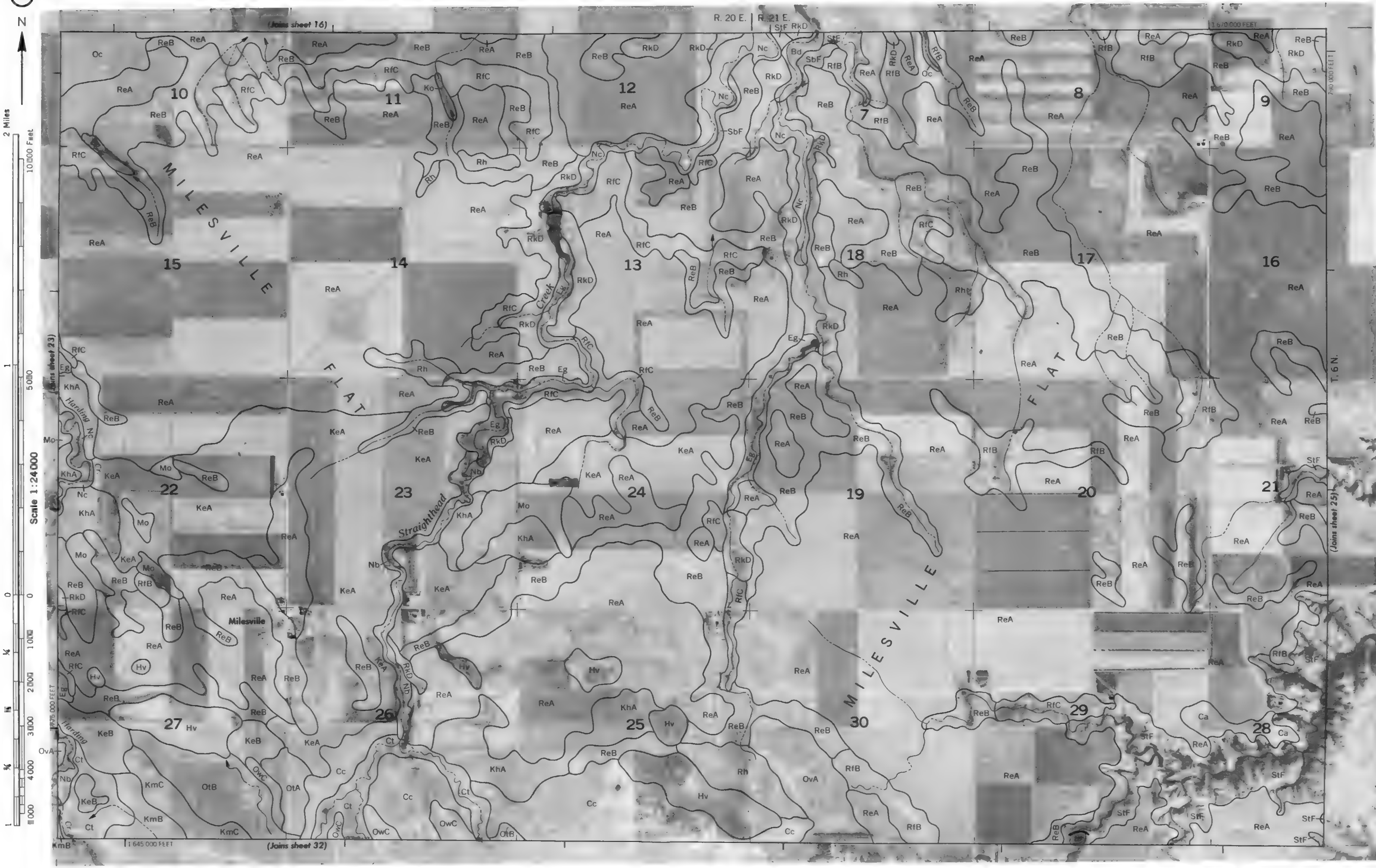


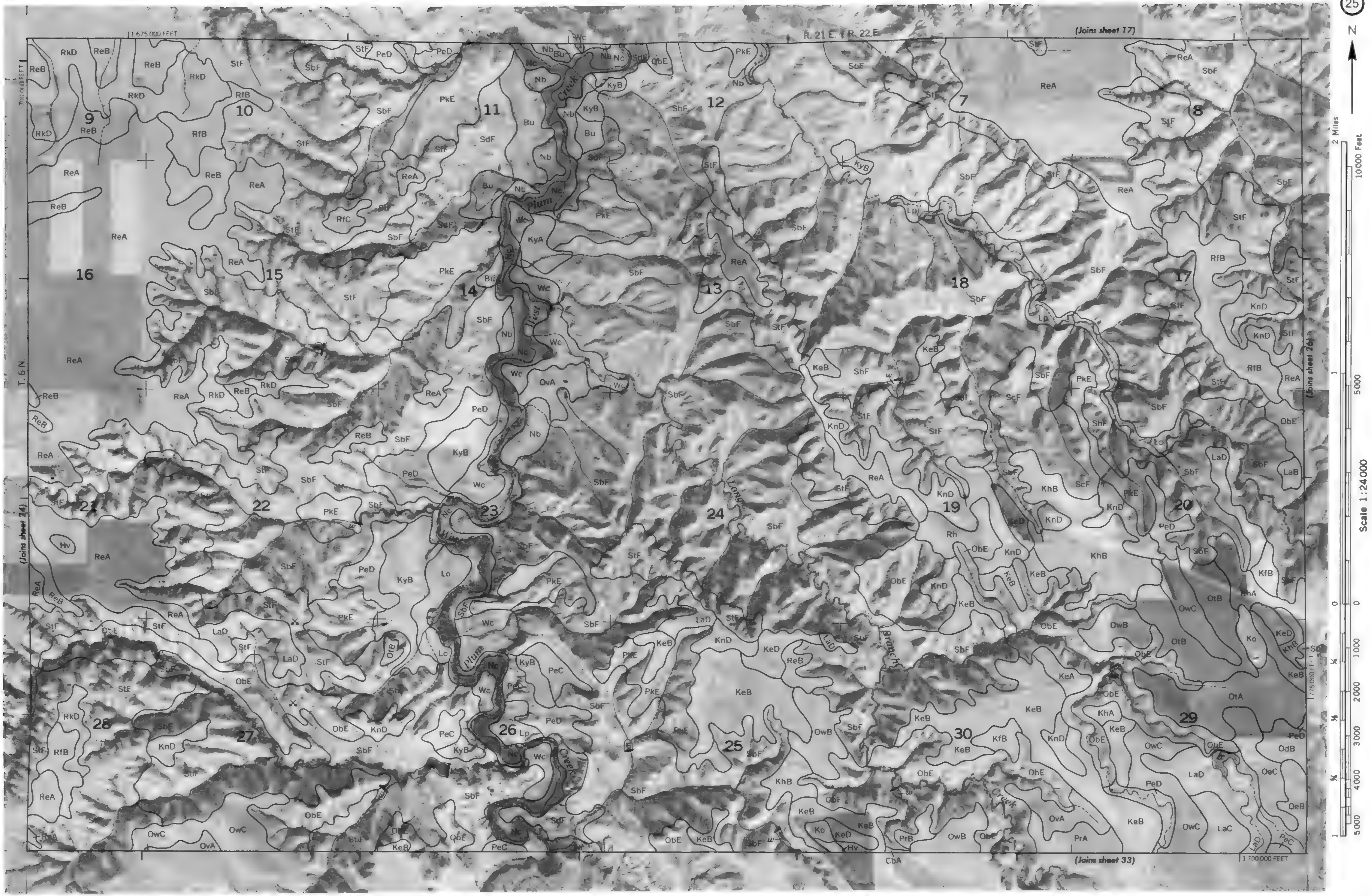

N
2 Miles
10 000 Feet
Scale 1:24000
(Joins sheet 12)
R. 24 E.
1 785 000 FEET
(Joins sheet 19)
(Joins sheet 28)
1 760 000 FEET
Hermaphrodite Creek
STANLEY COUNTY
T. 7 N.
T. 6 N.
25
26
27
28
29
32
33
34
35
36
1
2
3
4
5
8
9
10
11
12

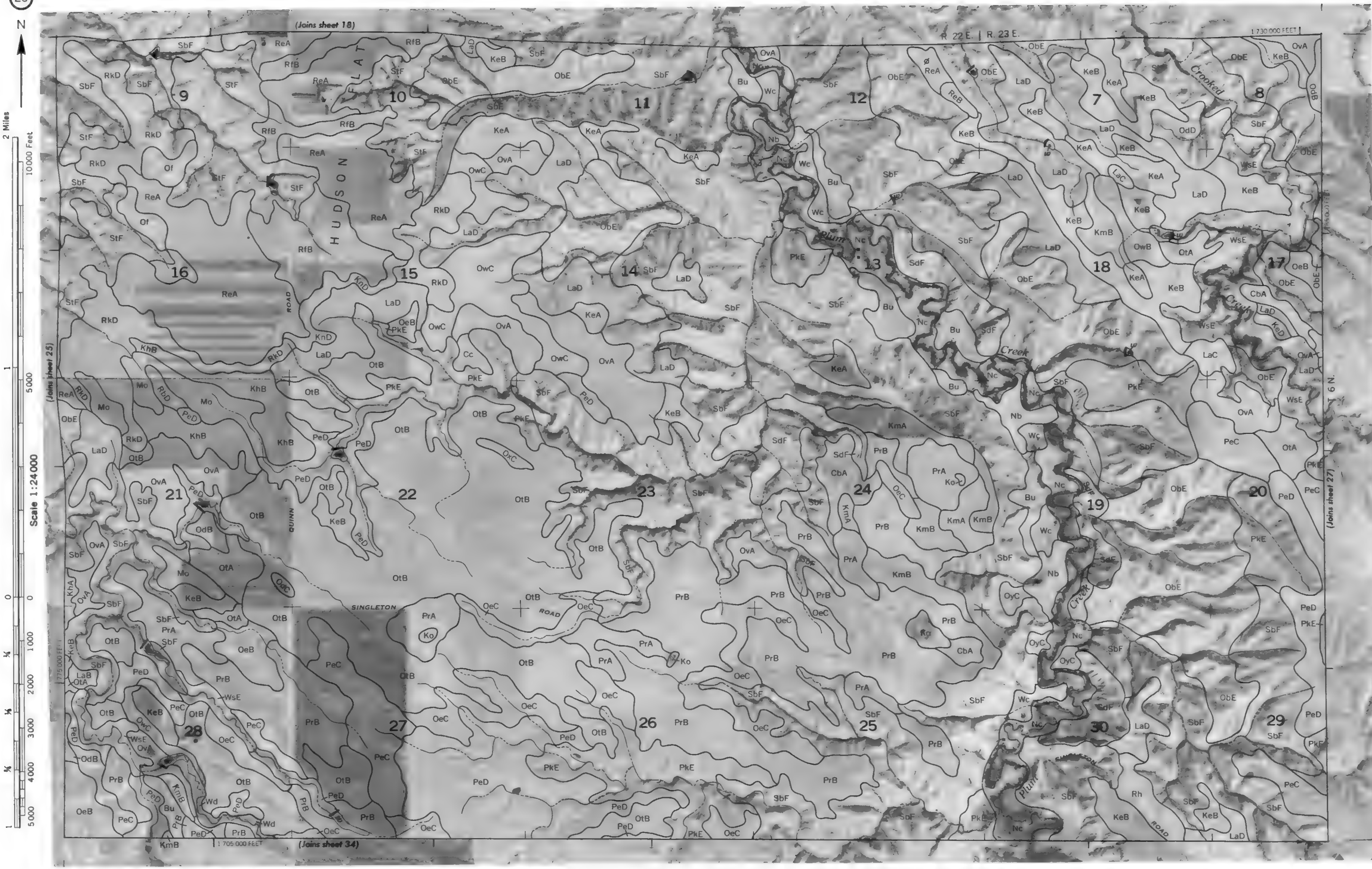

21
N
(Joins sheet 13)
(Joins sheet 22)
(Joins sheet 29)
R. 18 E.
PENNINGTON COUNTY
Barthold Flat
CARNAHAN FLAT
Ash Creek
Bridger Creek
Dunn Draw
Elm Tree Draw
Hell Draw
Scale 1:24000
2 Miles
10000 Feet
1 560 000 FEET
1 595 000 FEET
7
8
9
10
15
16
17
18
19
20
21
22
27
28
29
30

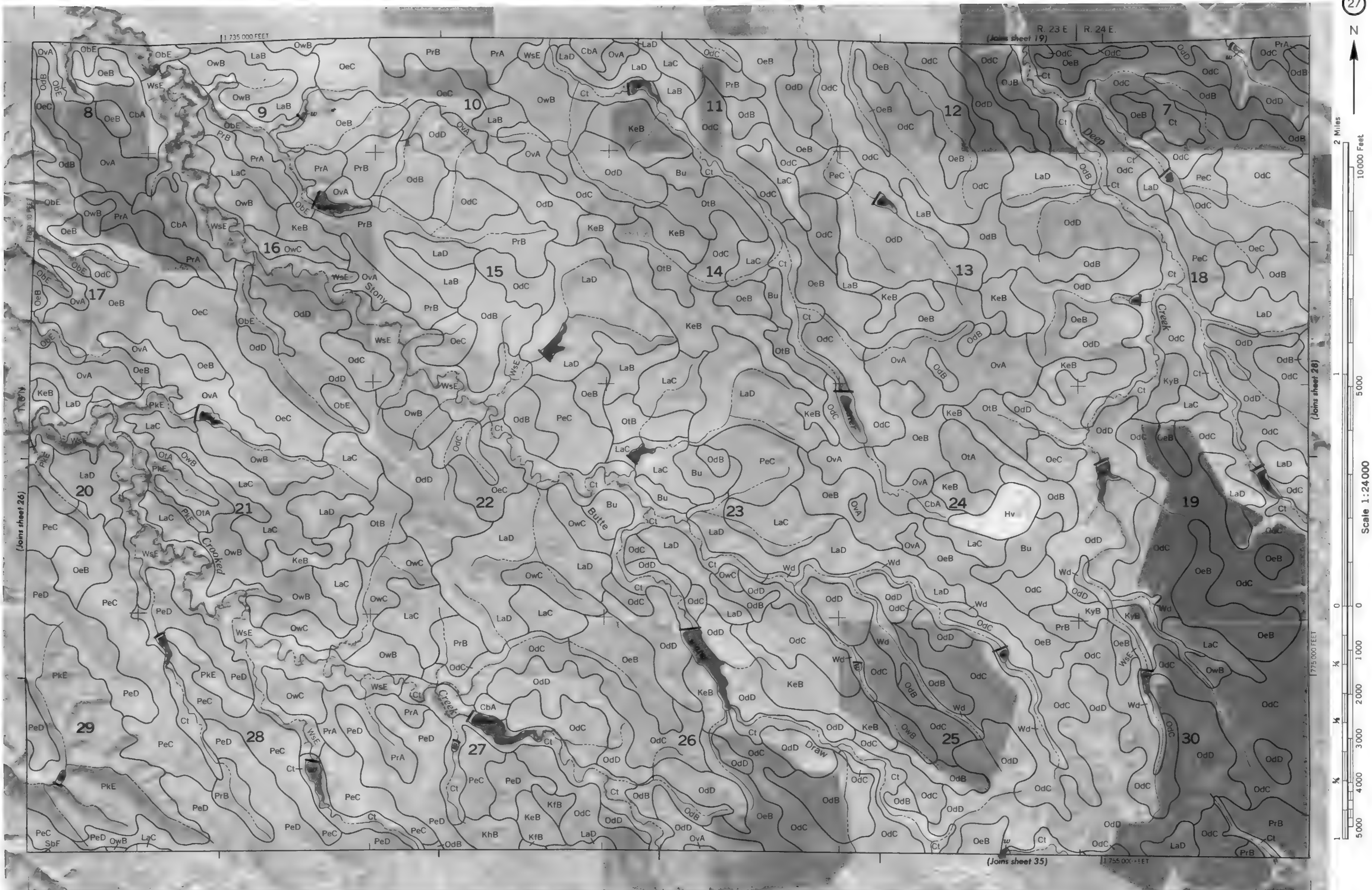

N
2 Miles
10 000 Feet
Scale 1:24000
(Joins sheet 14)
R. 18 E.
1 610 000 FEET
(Joins sheet 21)
(Joins sheet 23)
790 000 FEET
T. 6 N.
775 000 FEET
1 590 000 FEET
(Joins sheet 30)
Hall
Draw
Indian
Springs
Creek
Spotted
Bear
Cr.
Elm
Tree
Draw
Bridger
Cr.
Bear
Draw
ReA
RfB
RfC
StF
SbF
SdF
PkE
KmB
Ca
Oc
Lp
KeB
KeA
OtB
Ko
CbA
Mo
Hv
OvA
KmC


23
N
(Joins sheet 15)
R. 19 E. | R. 20 E.
T. 6 N.
(Joins sheet 23)
(Joins sheet 24)
(Joins sheet 31)
1 640 000 FEET
1 615 000 FEET
770 000 FEET
775 000 FEET
M I L E S V I L L E
F L A T
East Fork
Spotted Bear Creek
West Fork
Spotted Bear Creek
Harding Creek
2 Miles
10 000 Feet
Scale 1:24000

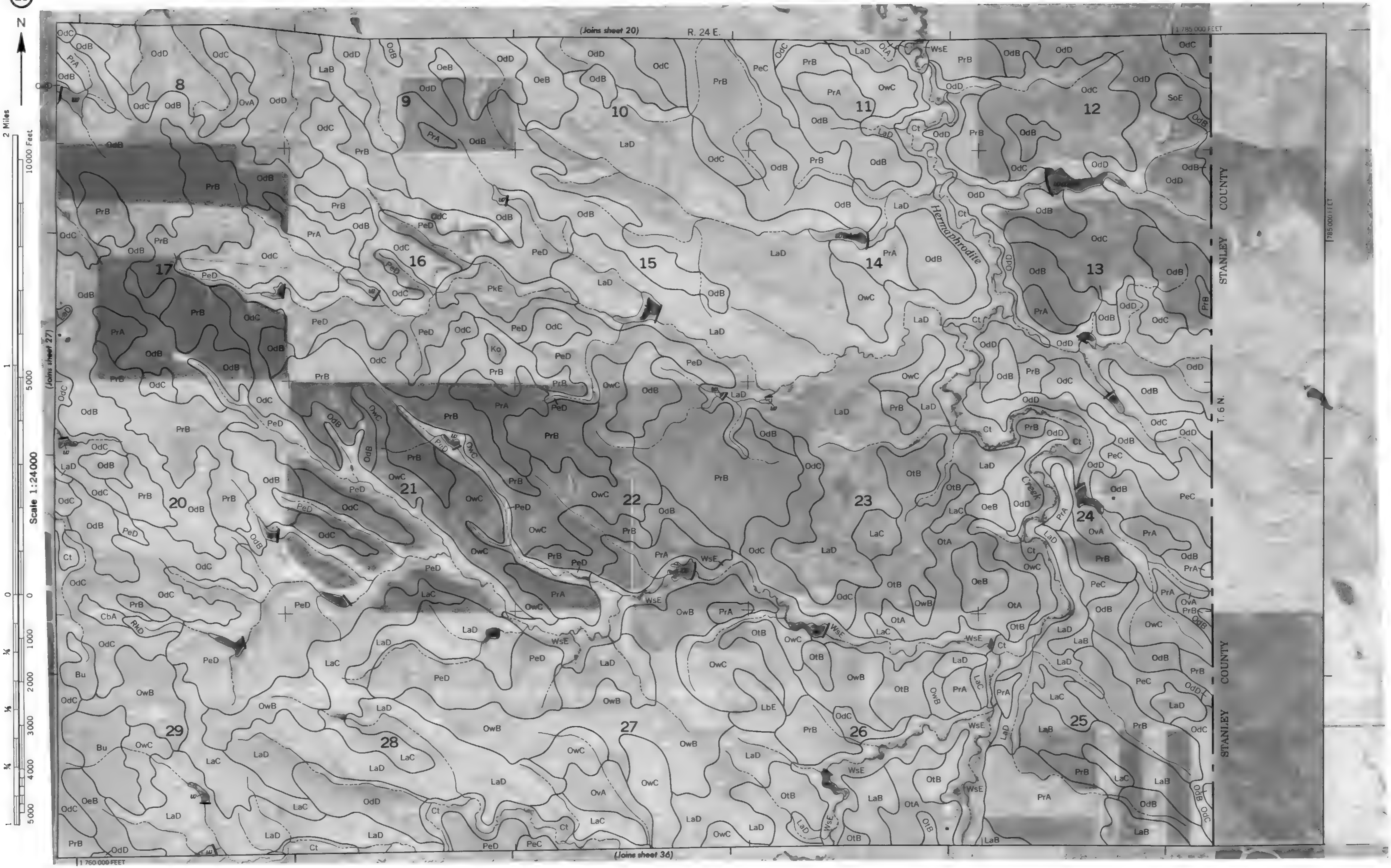

N
(Joins sheet 16)
R. 20 E.
R. 21 E.
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 32)
T. 6 N.
Scale 1:24000
2 Miles
10 000 Feet
1 670 000 FEET
1 645 000 FEET
MILESVILLE FLAT
FLAT
MILESVILLE
Straighthead
Creek
Harding
Milesville
10
11
12
7
8
9
15
14
13
18
17
16
22
23
24
19
20
21
27
26
25
30
29
28


(Joins sheet 17)
R. 21 E. | R. 22 E.
1 675 000 FEET
T. 6 N.
(Joins sheet 24)
(Joins sheet 26)
(Joins sheet 33)
1 700 000 FEET
N
Plum Creek
West
Long
Branch
Creek
Scale 1:24000
2 Miles
10 000 Feet
5000
0
1000
2000
3000
4000
5000

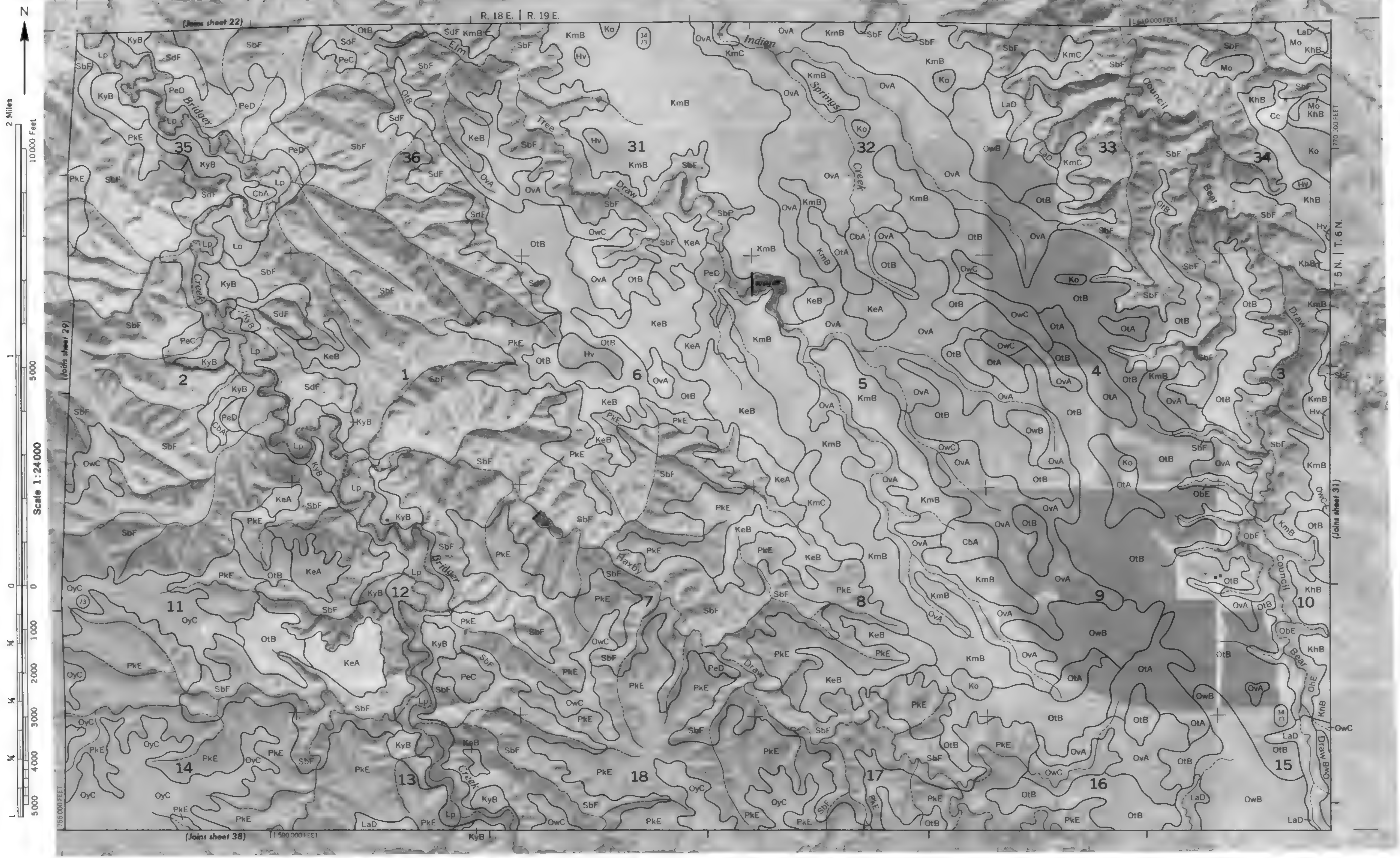

N
(Joins sheet 18)
(Joins sheet 25)
(Joins sheet 27)
(Joins sheet 34)
R. 22 E. | R. 23 E.
T. 6 N.
1 730 000 FEET
1 705 000 FEET
775 000 FEET
Scale 1:24 000
2 Miles
10 000 Feet
5000
HUDSON FLAT
QUINN ROAD
SINGLETON ROAD
Plum Creek
Crooked Creek


27
N
R. 23 E.
R. 24 E.
(Joins sheet 19)
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 35)
1 735 000 FEET
1 755 000 FEET
775 000 FEET
Scale 1:24000
2 Miles
1
0
10000 Feet
5000
0
Deep Creek
Stony
Butte
Crooked
Creek
Draw

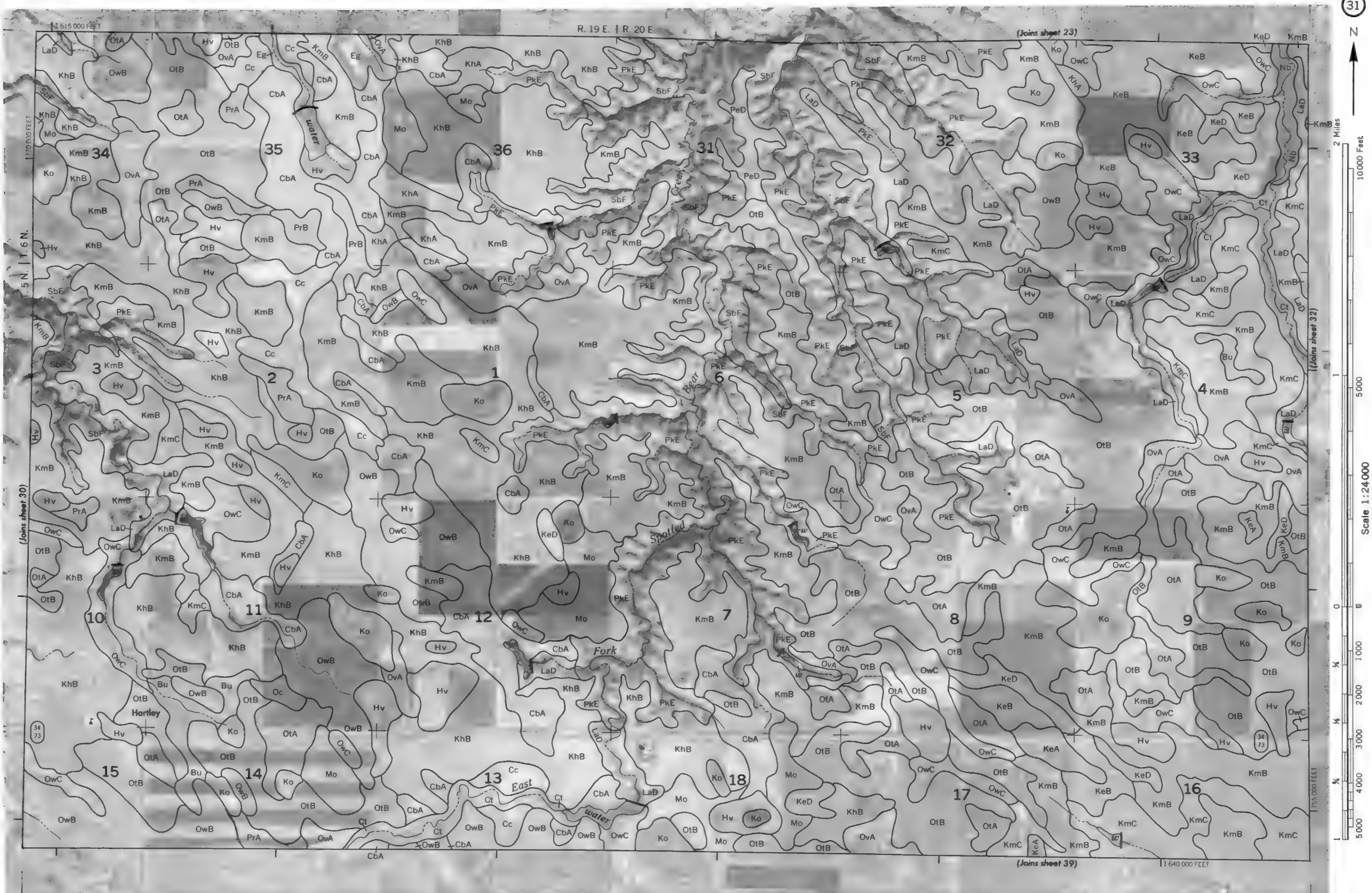
HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 28



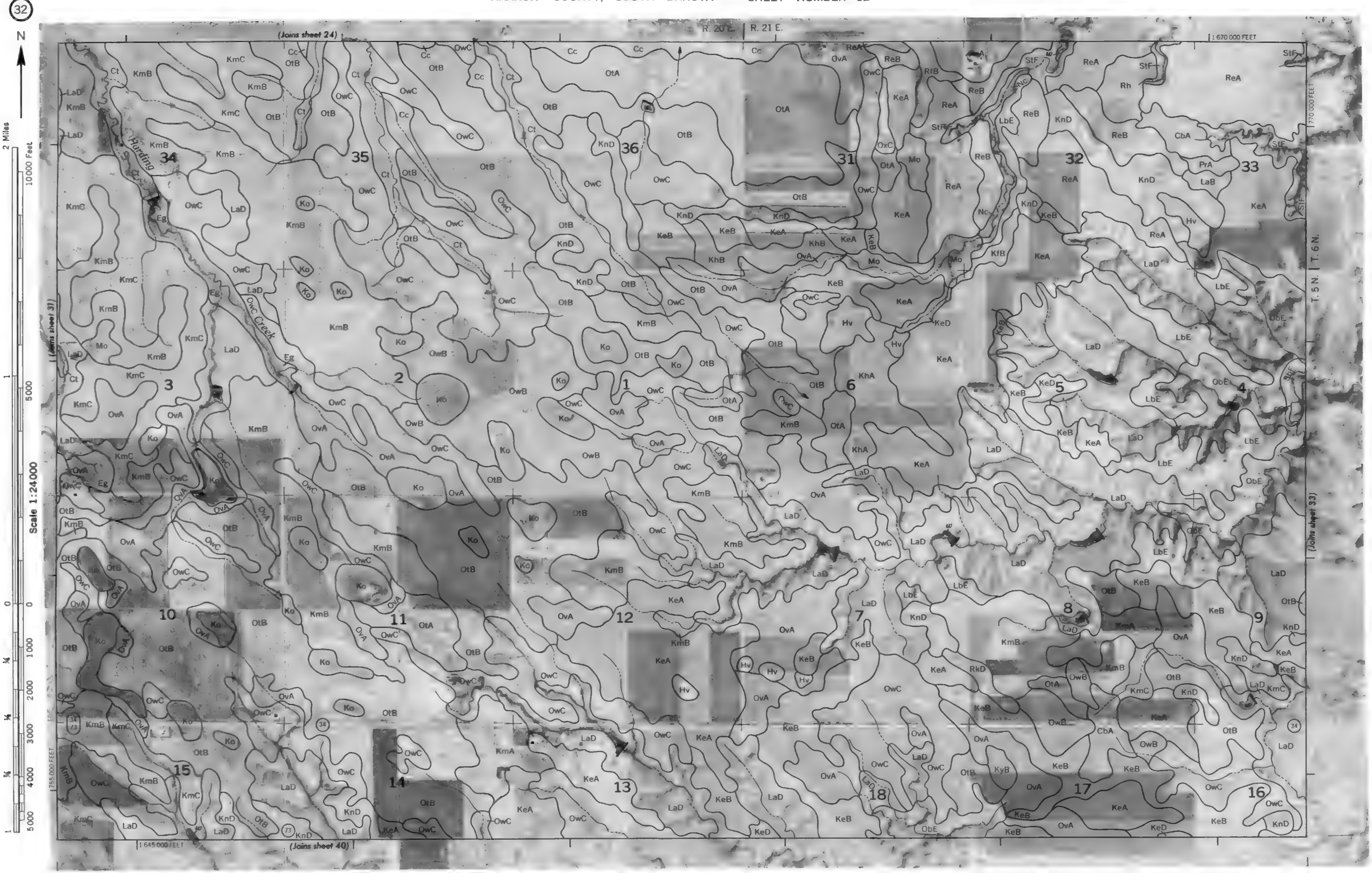

29
N
R. 18 E.
(Joins sheet 21)
(Joins sheet 30)
(Joins sheet 37)
1 560 000 FEET
1 585 000 FEET
770 000 FEET
755 000 FEET
T 6 N
T 5 N
PENNINGTON COUNTY
Ash Creek
Dunn Draw
Scale 1:24 000
2 Miles
1
0
10 000 Feet
5000
1000
2000
3000
4000
31
32
33
34
3
4
5
6
7
8
9
10
15
16
17
18
SdF
SbF
PkE
Lp
KyB
PeC
PeD
OwC
Hv
KeB
OxC
RbD
OtB
SrB
SrA
OyC

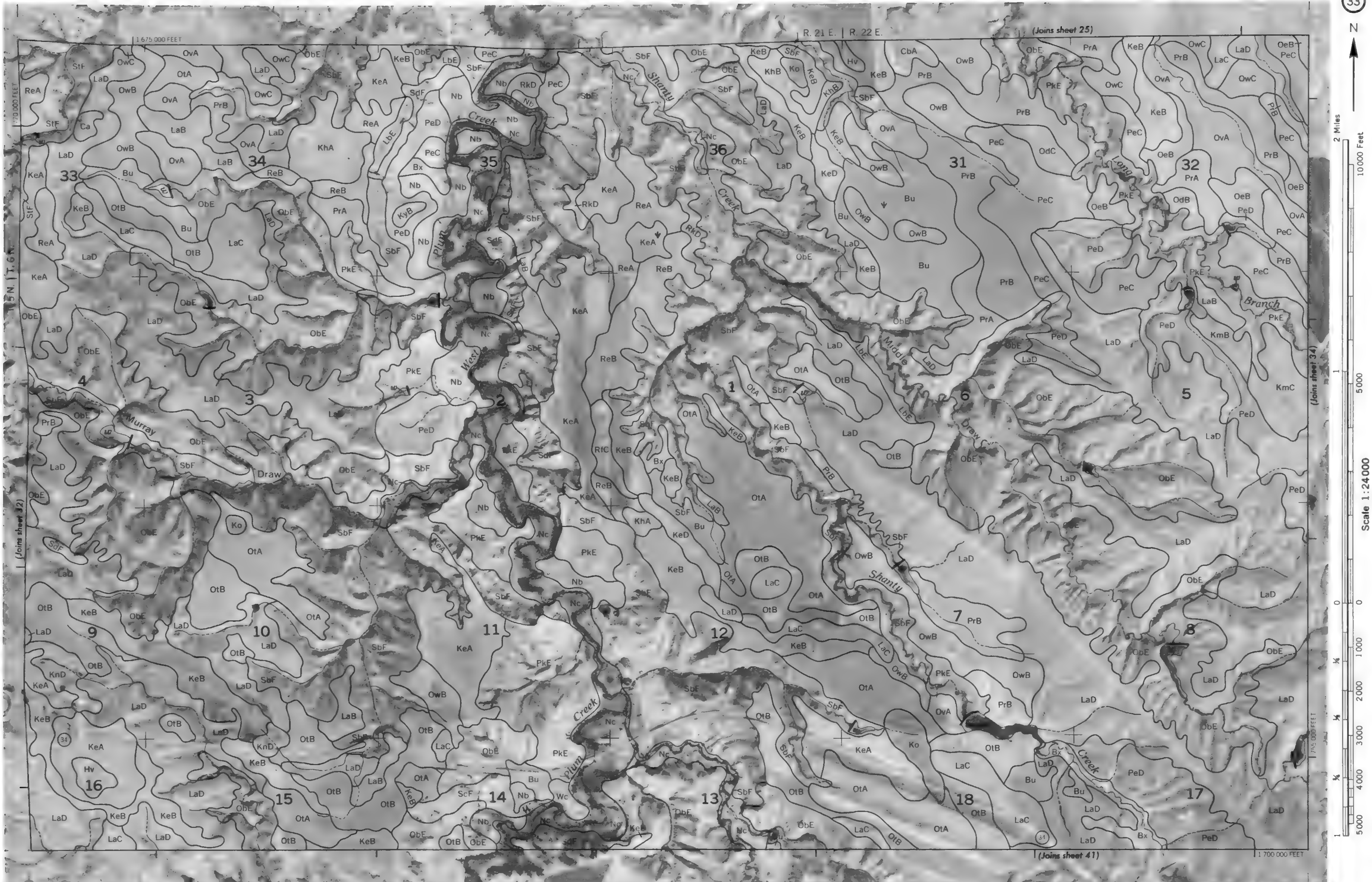

N
2 Miles
10000 Feet
5000
0
Scale 1:24000
(Joins sheet 22)
R. 18 E. | R. 19 E.
1 610 000 FEET
770 000 FEET
T. 5 N. | T. 6 N.
(Joins sheet 29)
(Joins sheet 31)
(Joins sheet 38)
1 590 000 FEET
755 000 FEET
Bridger Creek
Elm Tree Draw
Indian Springs Creek
Council Bear Draw
Haxby Draw
35
36
31
32
33
34
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

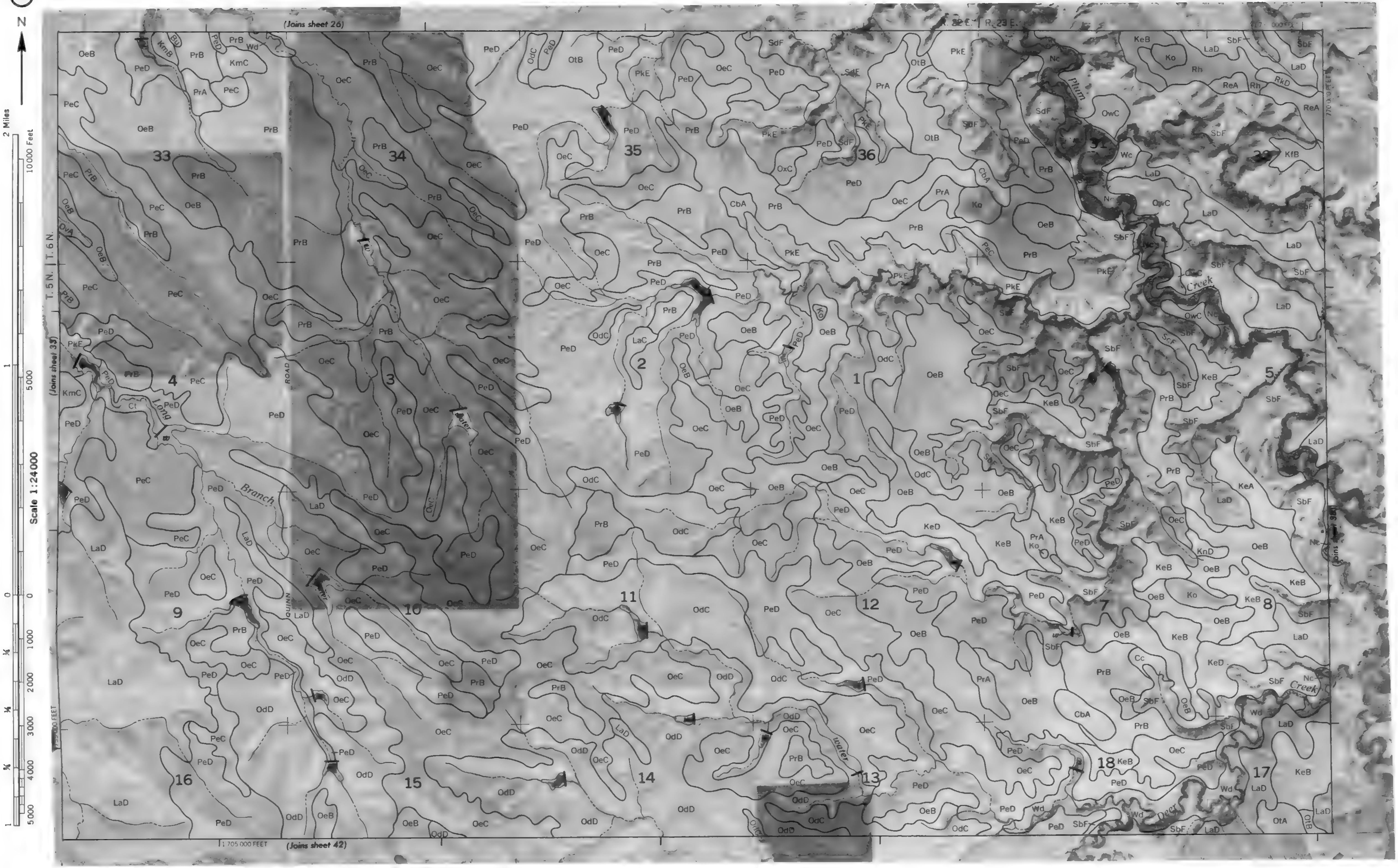
HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 31

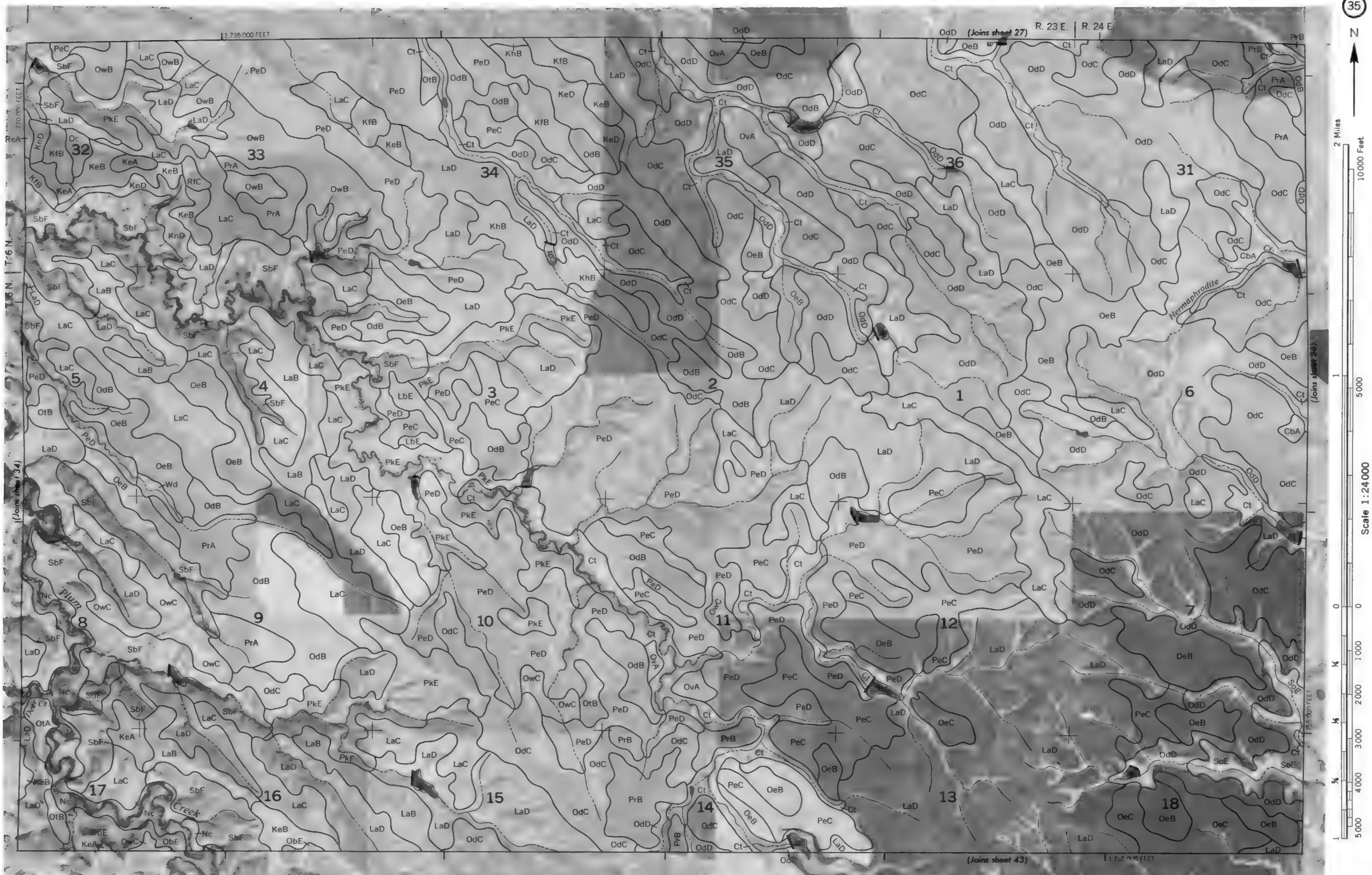


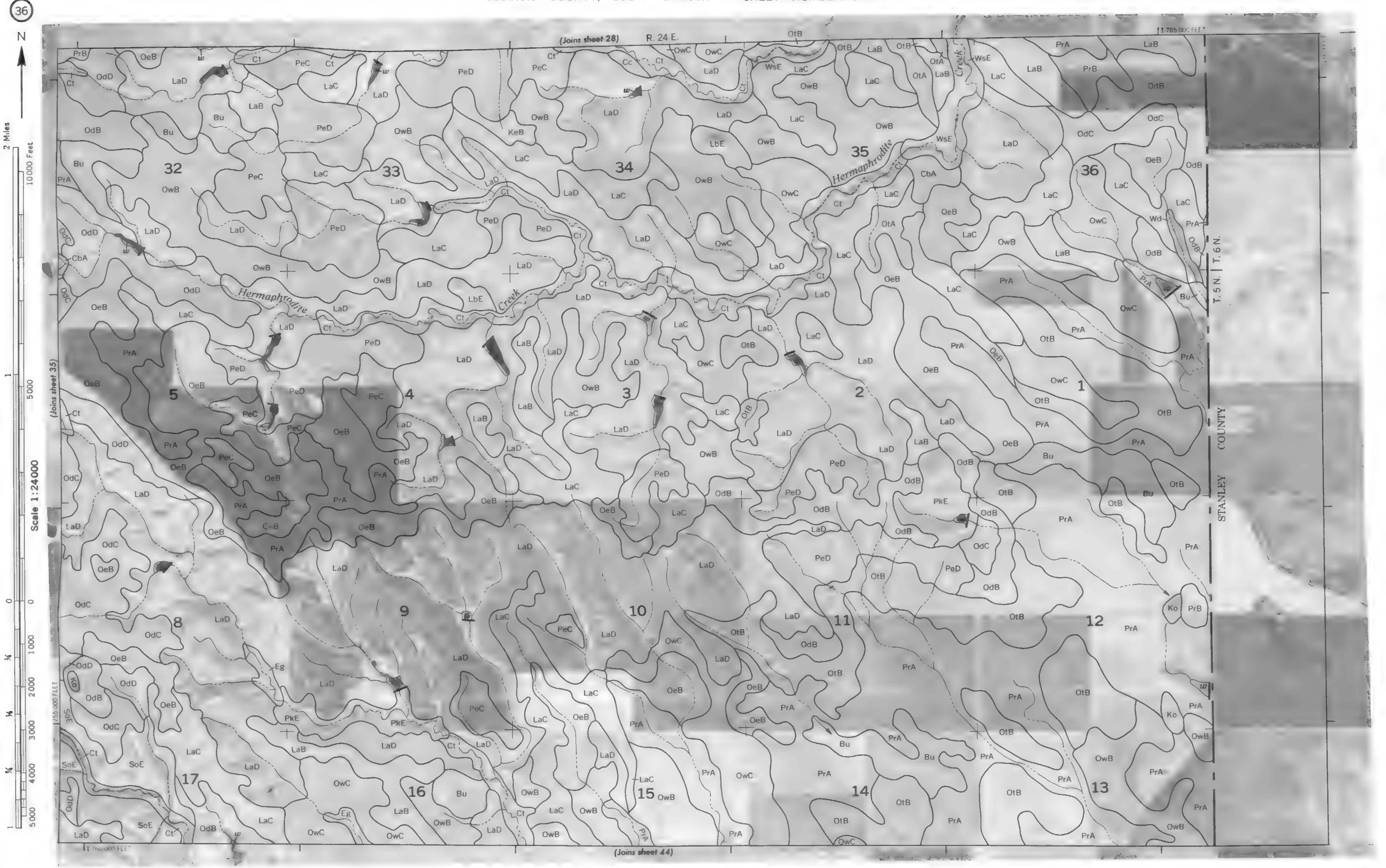
HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 32



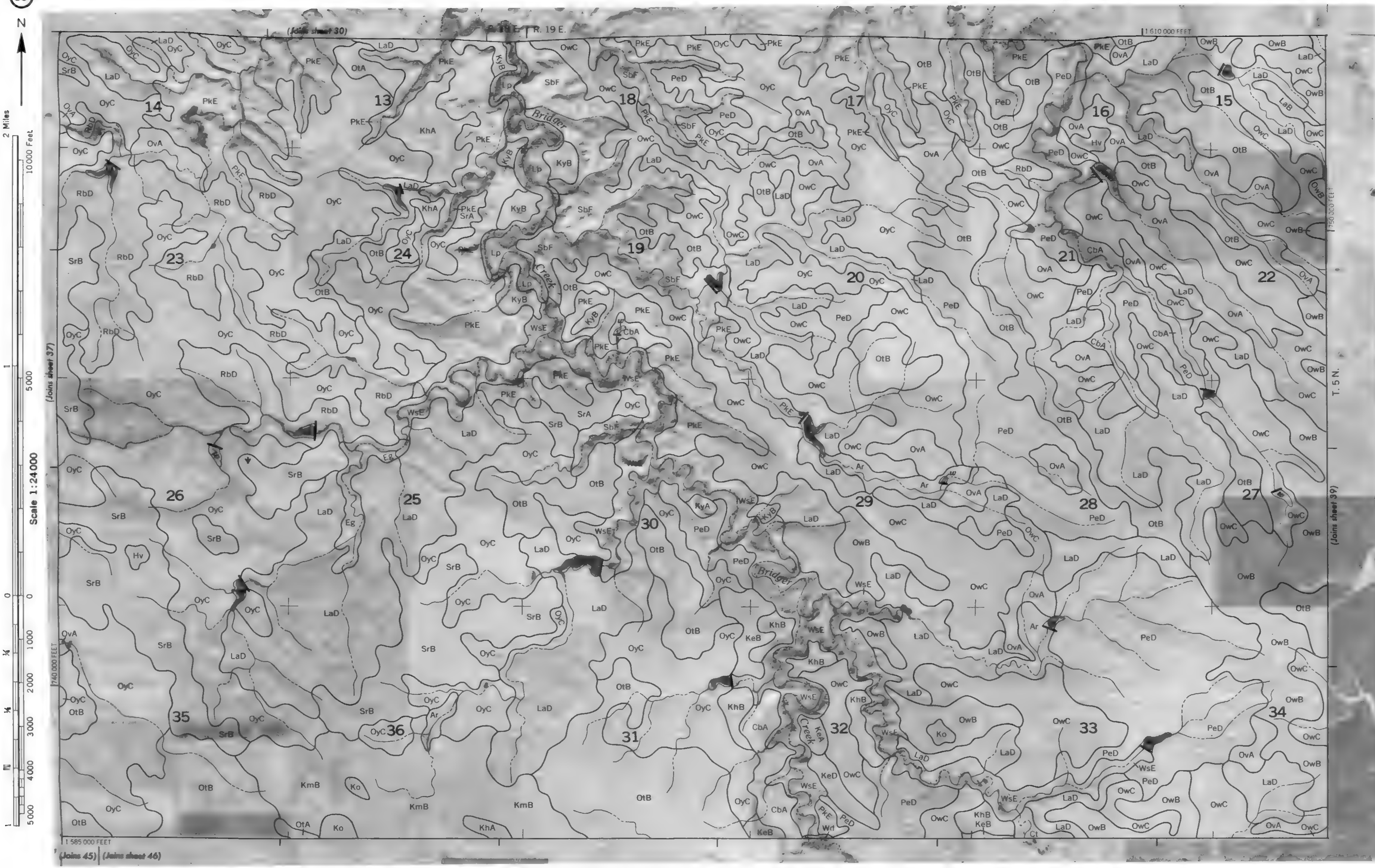

N
(Joins sheet 25)
(Joins sheet 41)
(Joins sheet 32)
(Joins sheet 34)
R. 21 E. | R. 22 E.
1 675 000 FEET
1 700 000 FEET
T. 6 N. | T. 5 N.
Shanty Creek
Plum Creek
West Creek
Murray Draw
Middle Draw
Long Branch
Creek
Scale 1:24000
2 Miles
10 000 Feet
5000
0
1000
2000
3000
4000
5000
1

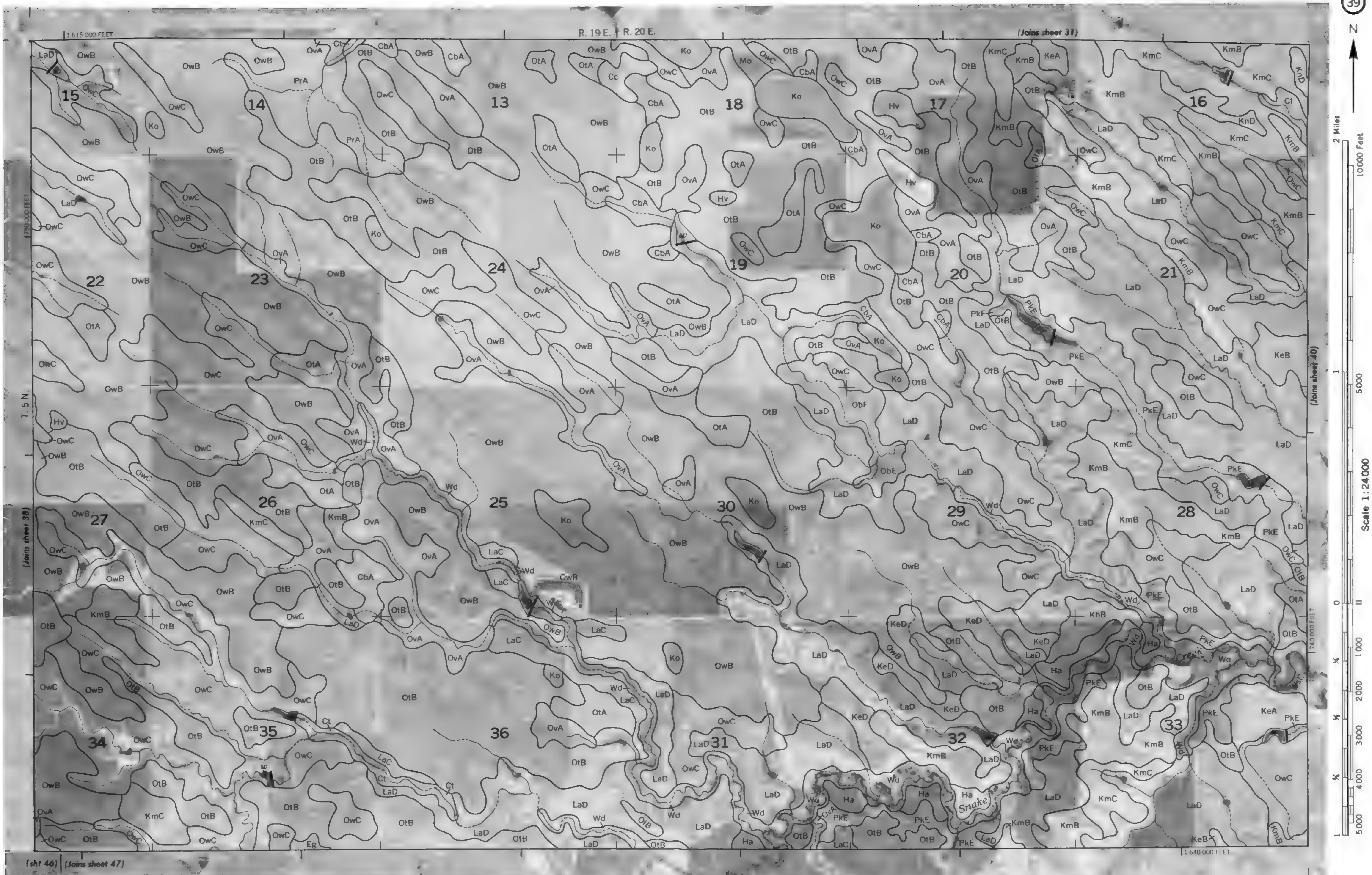

34
N
2 Miles
10000 Feet
Scale 1:24000
(Joins sheet 26)
(Joins sheet 42)
(Joins sheet 33)
(Joins sheet 35)
R. 22 E. | R. 23 E.
T. 6 N.
T. 5 N.
ROAD
Long
Branch
Plum
Creek
Deer
Creek
1 705 000 FEET


35
N
(Joins sheet 27)
R. 23 E.
R. 24 E.
1 735 000 FEET
T. 6 N.
(Joins sheet 34)
(Joins sheet 36)
(Joins sheet 43)
Hermaphrodite Cr.
Plum Creek
Scale 1:24000
2 Miles
10000 Feet

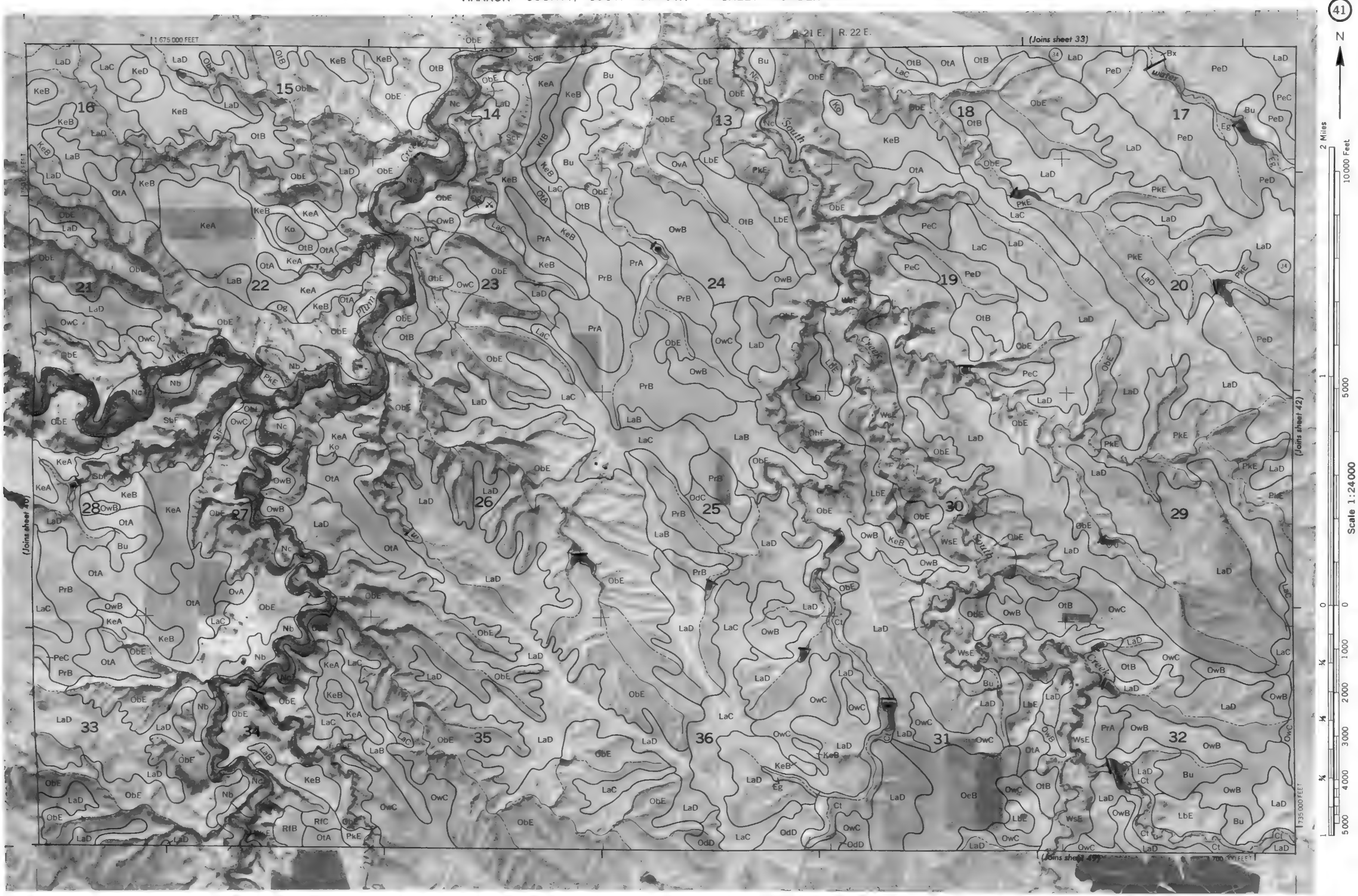

36
N
2 Miles
10000 Feet
5000
Scale 1:24000
(Joins sheet 28)
R. 24 E.
(Joins sheet 35)
(Joins sheet 44)
T. 6 N.
T. 5 N.
STANLEY COUNTY
Hermaphrodite Creek
1 785 000 FEET
255 000 FEET
1 760 000 FEET
32
33
34
35
36
5
4
3
2
1
8
9
10
11
12
17
16
15
14
13

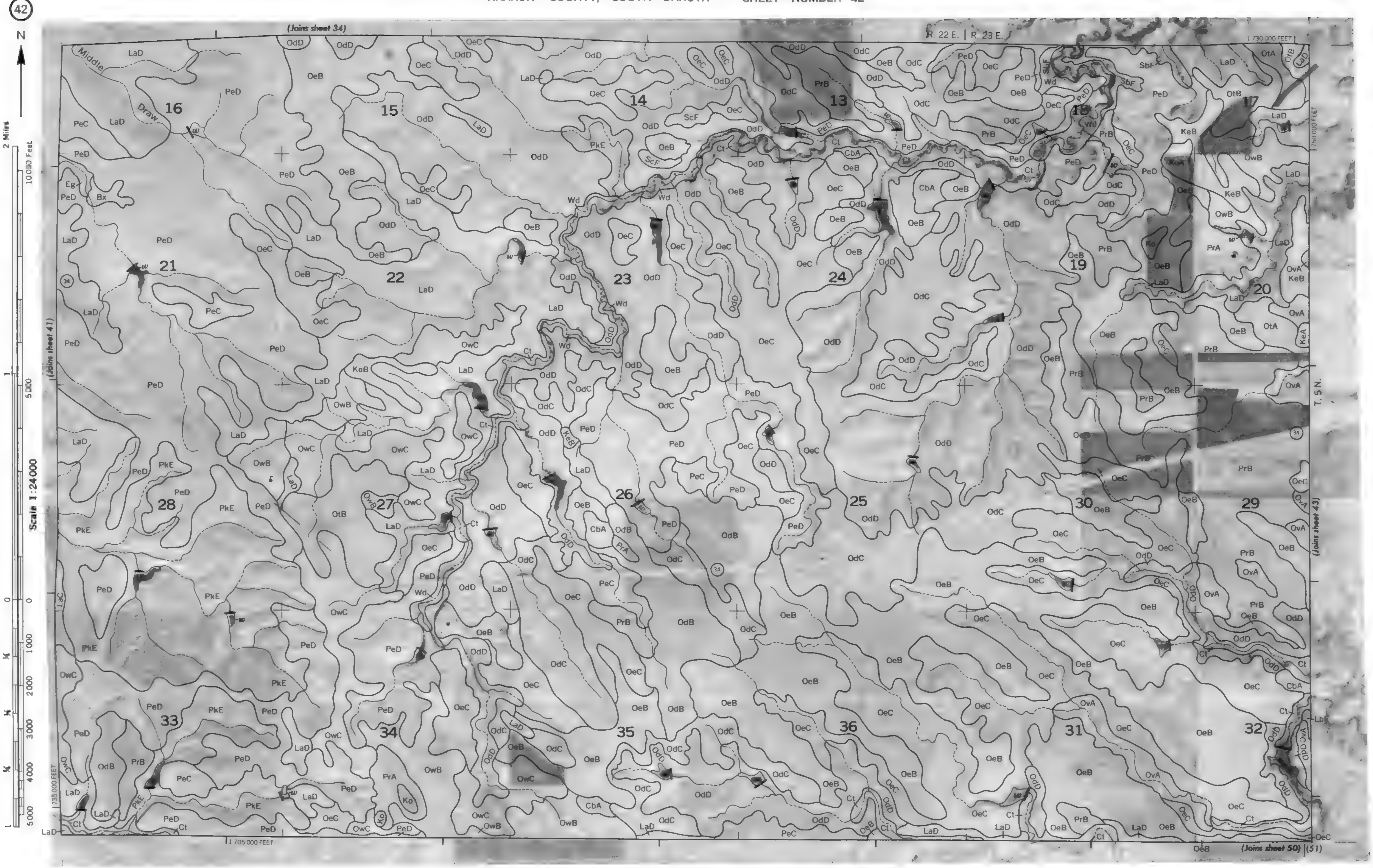

37
N
R. 18 E.
(Joins sheet 29)
(Joins sheet 38)
(Joins sheet 45)
1 960 000 FEET
1 585 000 FEET
740 000 FEET
PENNINGTON COUNTY
PENNINGTON COUNTY
PENNINGTON COUNTY
T. 5 N.
15
16
17
18
19
20
21
22
27
28
29
30
31
32
33
34
Ash Creek
Creek
Scale 1:24 000
2 Miles
1
0
10 000 Feet
5000
0
1000
2000
3000
4000
5000
OxC
OtB
OyC
OvA
OtA
PkE
SbF
RbD
SrA
SrB
SrC
KyB
KeA
KeB
KhB
PeC
PeD
Lp
Ar
MaE


N
2 Miles
10000 Feet
5000
Scale 1:24 000
(Joins sheet 30)
R. 18 E. | R. 19 E.
1 610 000 FEET
750 000 FEET
T. 5 N.
(Joins sheet 39)
(Joins sheet 37)
740 000 FEET
1 585 000 FEET
(Joins 45) | (Joins sheet 46)
Bridger Creek


39
N
1 615 000 FEET
R. 19 E. | R. 20 E.
(Joins sheet 31)
750 000 FEET
T. 5 N.
(Joins sheet 38)
(Joins sheet 40)
740 000 FEET
1 640 000 FEET
(sht 46)
(Joins sheet 47)
Snake Creek
2 Miles
10000 Feet
Scale 1:24 000


N
(Joins sheet 32)
R. 20 E. | R. 21 E.
1 670 000 FEET
(Joins sheet 39)
(Joins sheet 41)
(47) | (Joins sheet 48)
1 645 000 FEET
740 000 FEET
T. 5 N.
Scale 1:24000
2 Miles
10 000 Feet
Plum Creek
West
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36

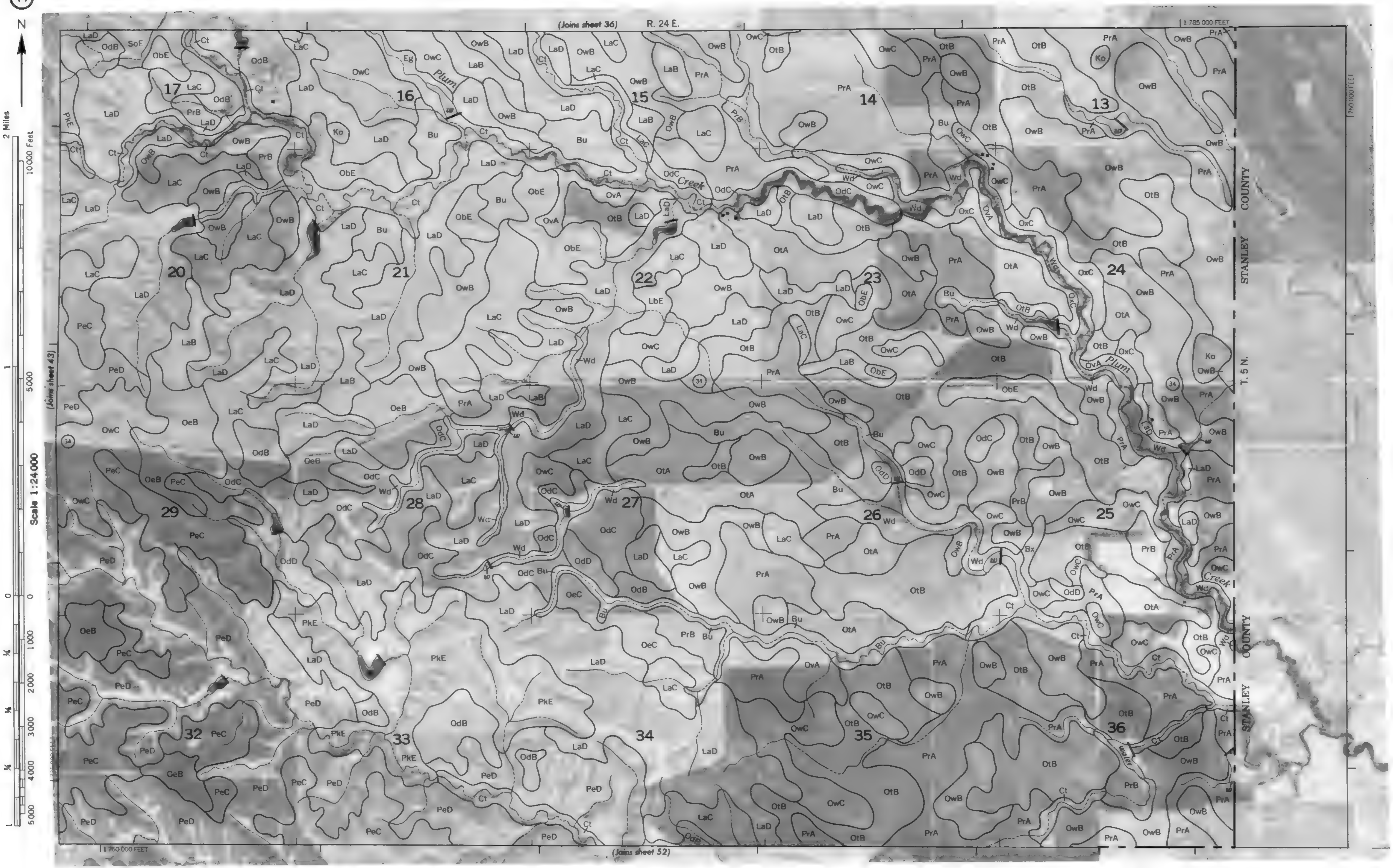

41
N
(Joins sheet 33)
R. 21 E.
R. 22 E.
(Joins sheet 40)
(Joins sheet 42)
(Joins sheet 49)
1 675 000 FEET
735 000 FEET
Scale 1:24 000
2 Miles
10000 Feet
5000
0
1000
2000
3000
4000
5000
1
¼
½
¾
South
Creek
Plum
Creek
West
water
Bx


42
N
(Joins sheet 34)
(Joins sheet 41)
(Joins sheet 43)
(Joins sheet 50)
(51)
R. 22 E. | R. 23 E.
T. 5 N.
Scale 1:24 000
2 Miles
10 000 Feet
1 730 000 FEET
750 000 FEET
735 000 FEET
1 705 000 FEET
Middle Draw
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36

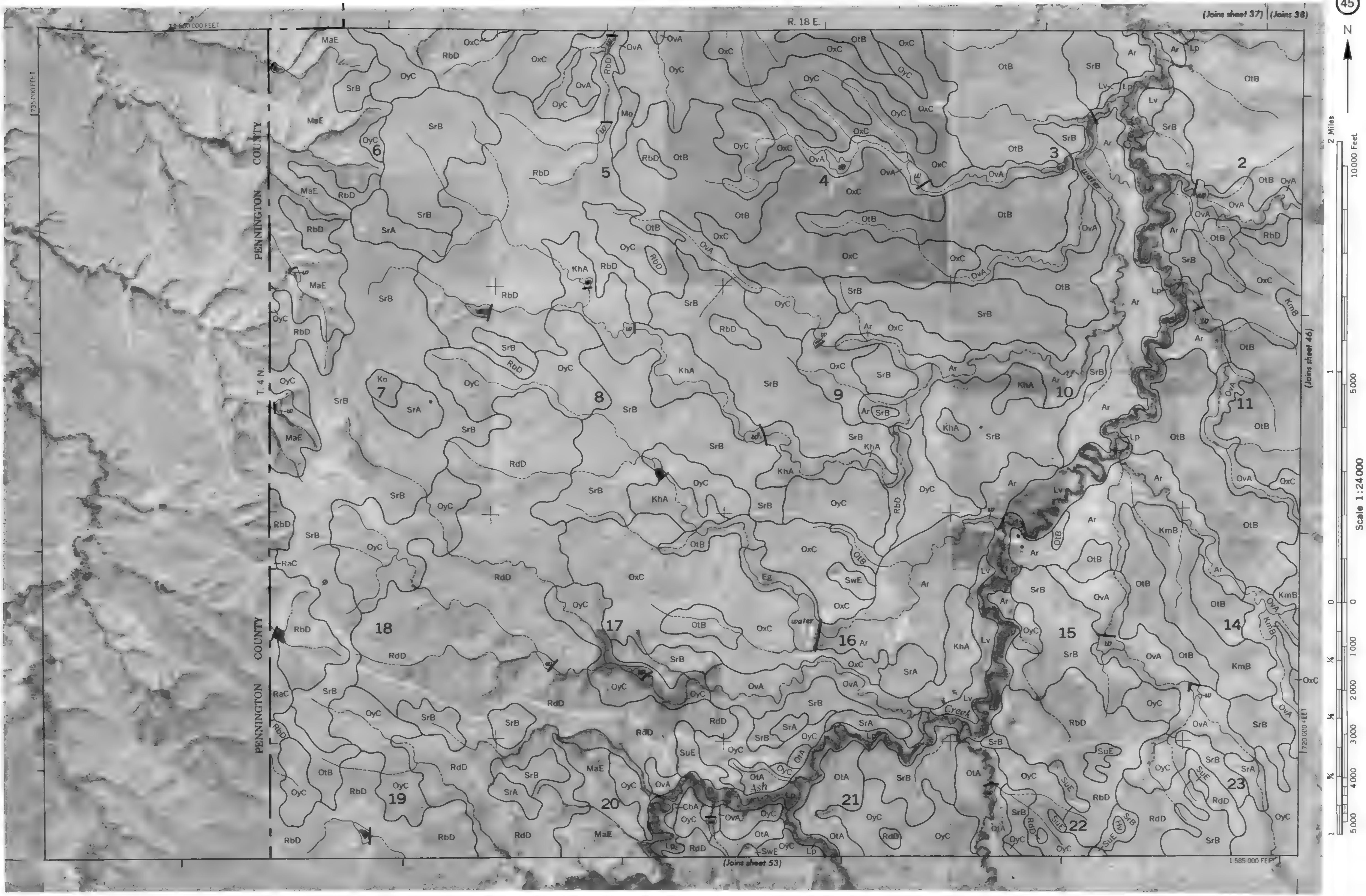

43
N
(Joins sheet 35)
R. 23 E.
R. 24 E.
(Joins sheet 42)
(Joins sheet 44)
(Joins sheet 51)
T. 5 N.
1 735 000 FEET
1 755 000 FEET
750 000 FEET
735 000 FEET
Plum
Creek
2 Miles
10 000 Feet
Scale 1:24 000

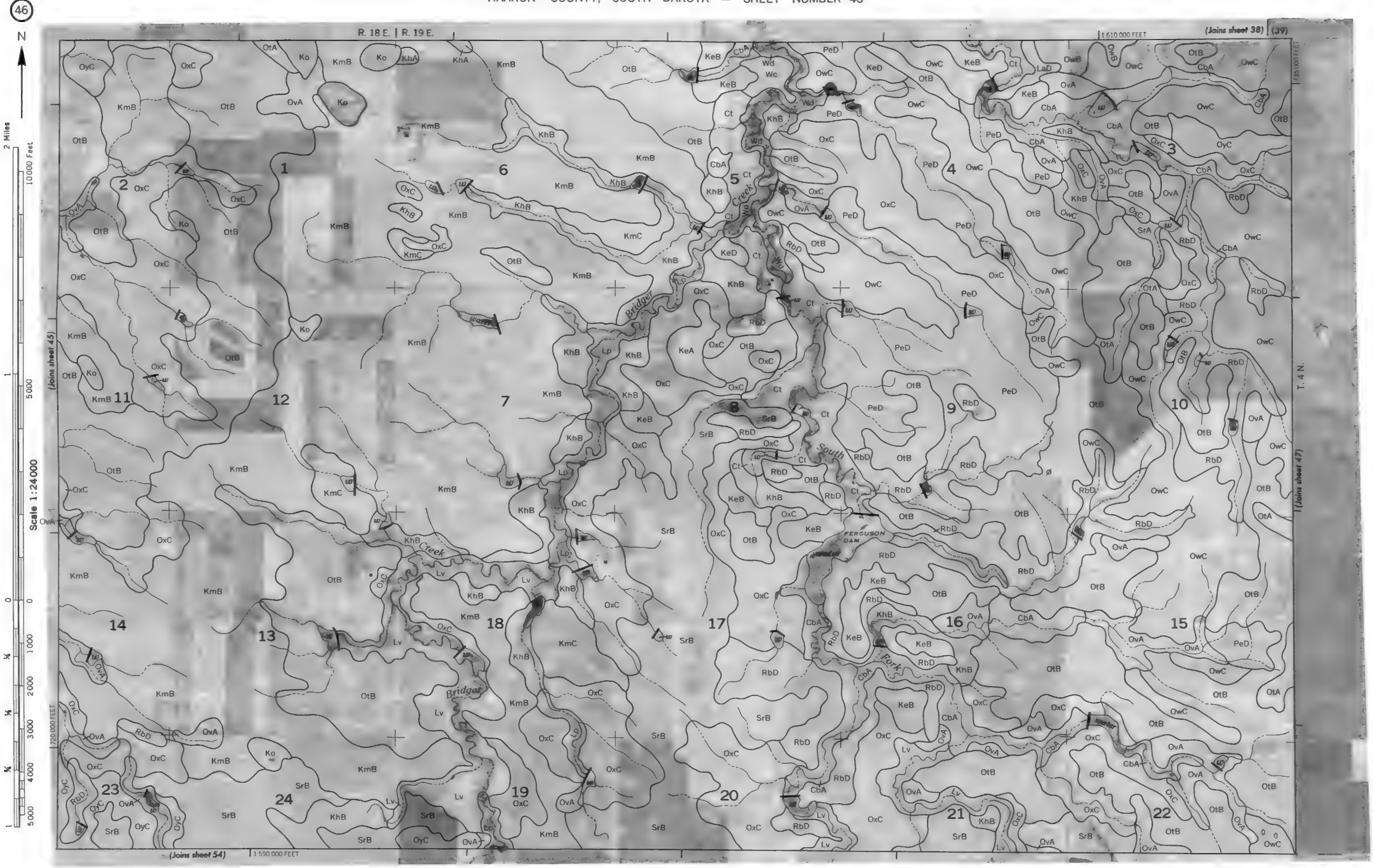
44

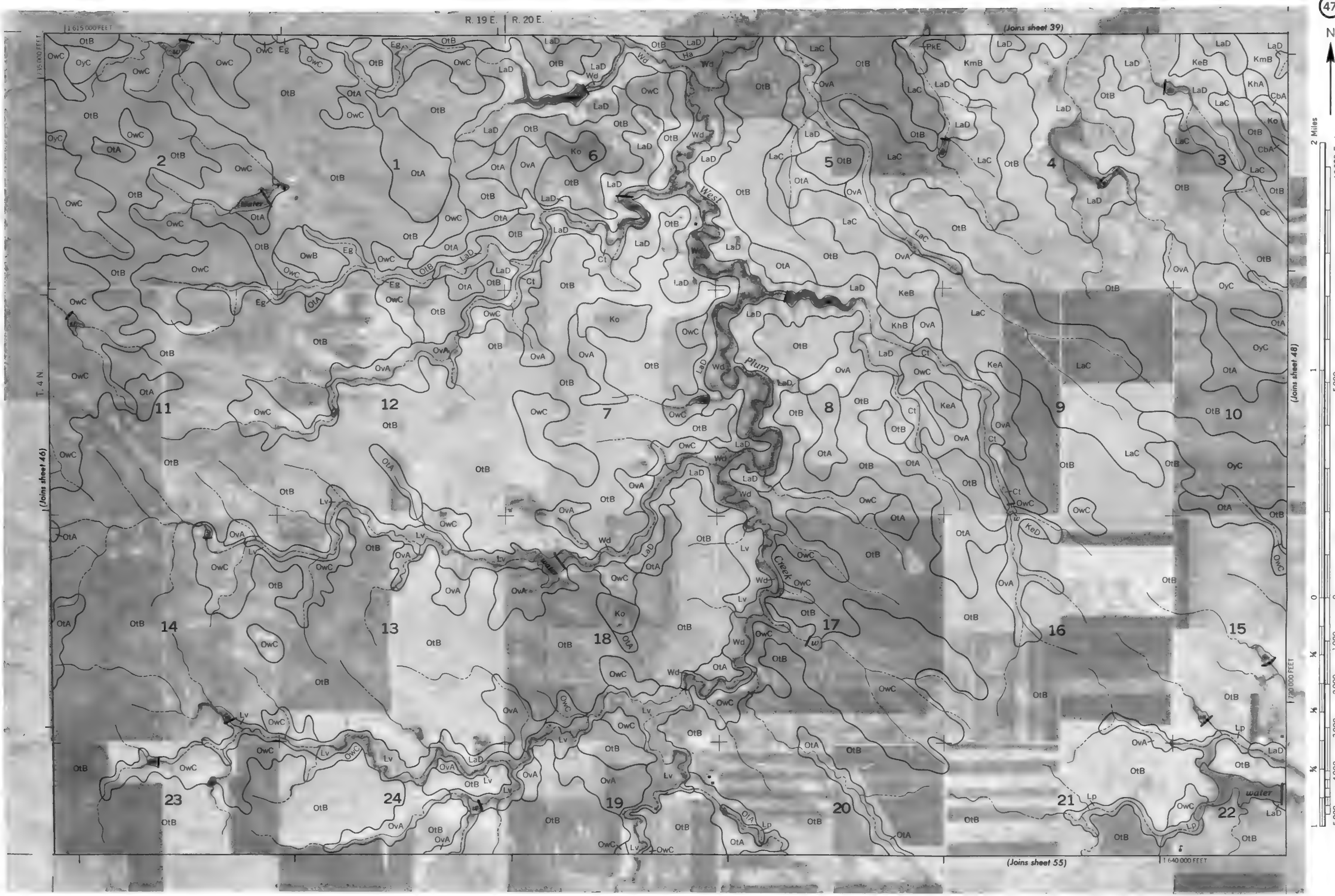
HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 44

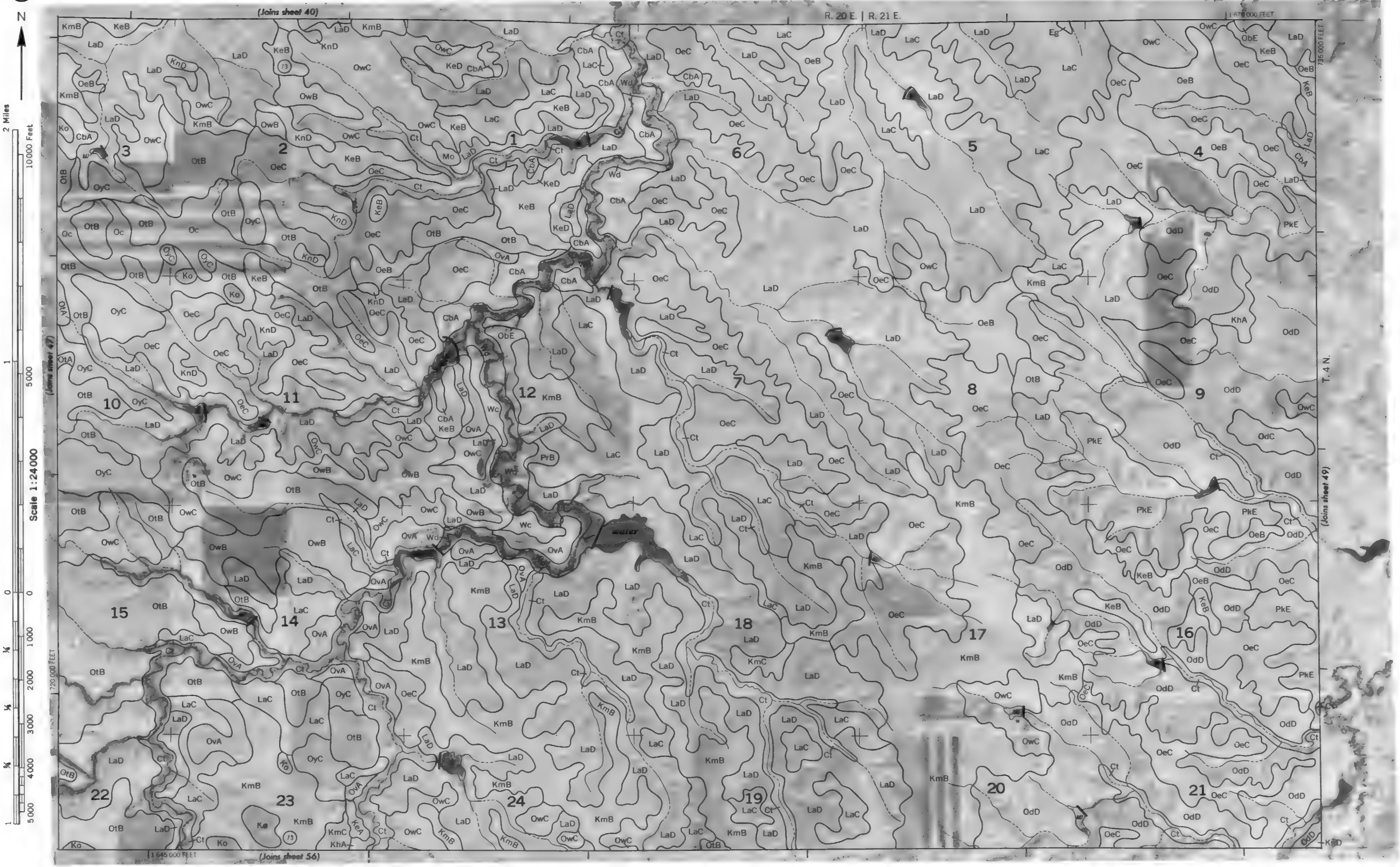


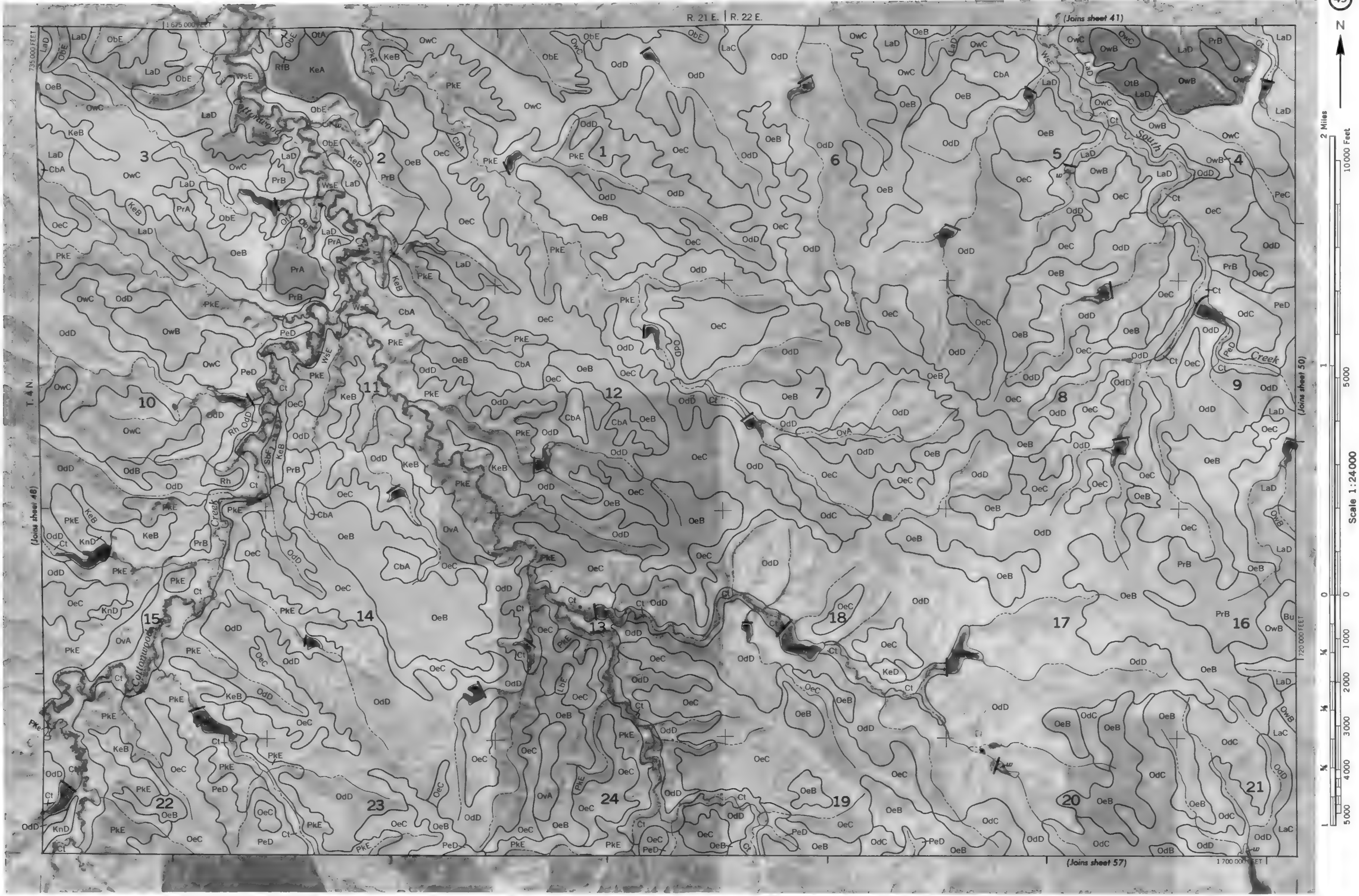
HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 45




46
N
Scale 1:24000
2 Miles
10 000 Feet
5000
R. 18 E. | R. 19 E.
(Joins sheet 38)
(39)
1 610 000 FEET
735 000 FEET
(Joins sheet 45)
(Joins sheet 47)
T. 4 N.
720 000 FEET
(Joins sheet 54)
1 590 000 FEET
Bridger Creek
South Fork
FERGUSON DAM
water
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24

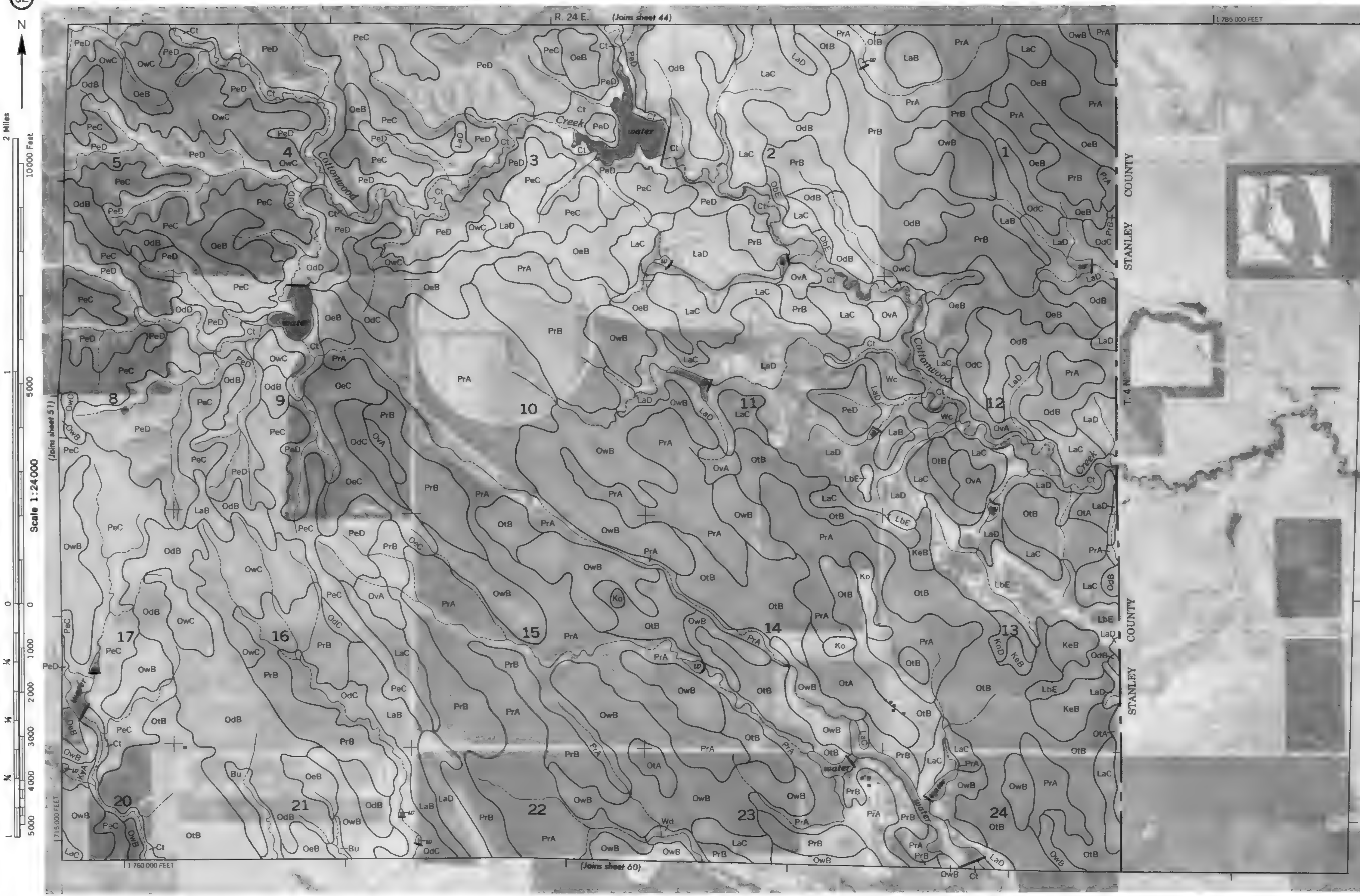

47
N
R. 19 E.
R. 20 E.
1 615 000 FEET
1 640 000 FEET
1 720 000 FEET
(Joins sheet 39)
(Joins sheet 48)
(Joins sheet 55)
(Joins sheet 46)
T. 4 N.
West
Plum
Creek
water
2 Miles
1
0
10000 Feet
5000
0
Scale 1:24 000


N
(Joins sheet 40)
R. 20 E. | R. 21 E.
1 670 000 FEET
735 000 FEET
T. 4 N.
(Joins sheet 49)
(Joins sheet 47)
(Joins sheet 56)
1 645 000 FEET
720 000 FEET
Scale 1:24 000
2 Miles
10000 Feet
water
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24


R. 21 E. | R. 22 E.
(Joins sheet 41)
(Joins sheet 48)
(Joins sheet 50)
(Joins sheet 57)
T. 4 N.
1 675 000 FEET
735 000 FEET
720 000 FEET
1 700 000 FEET
Cottonwood Creek
South Creek
N
2 Miles
10000 Feet
Scale 1:24 000

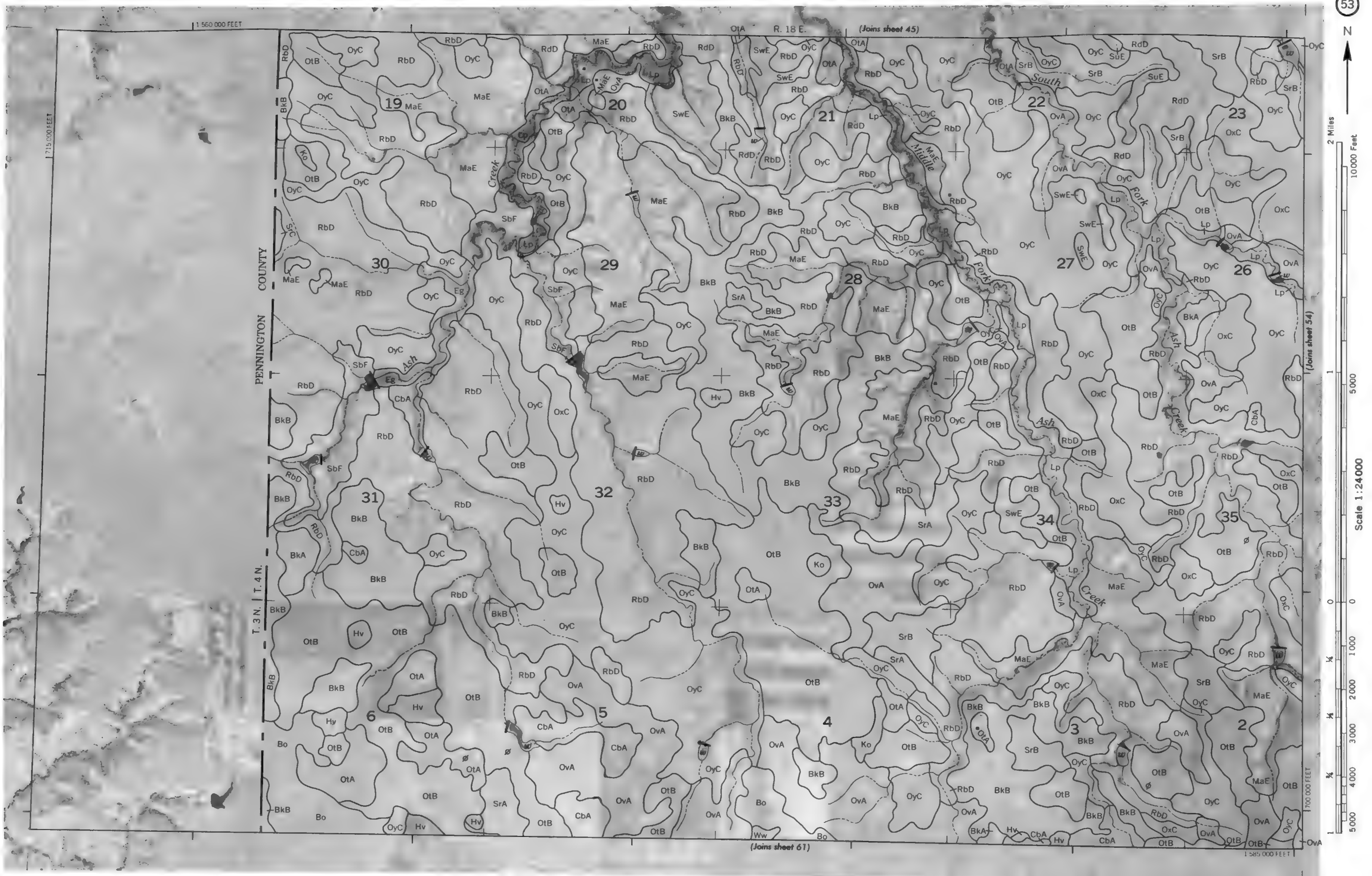
HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 51

HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 52

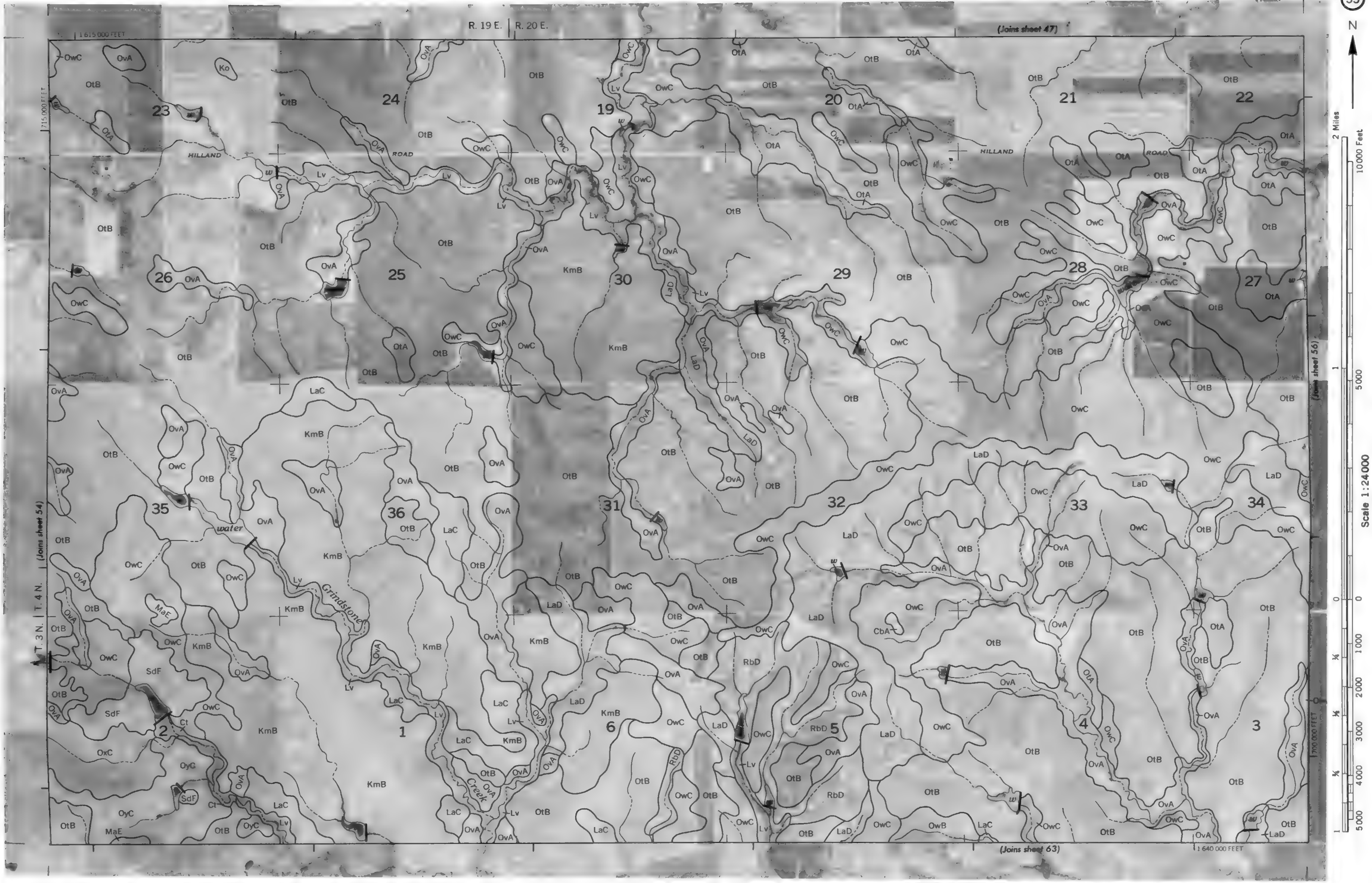


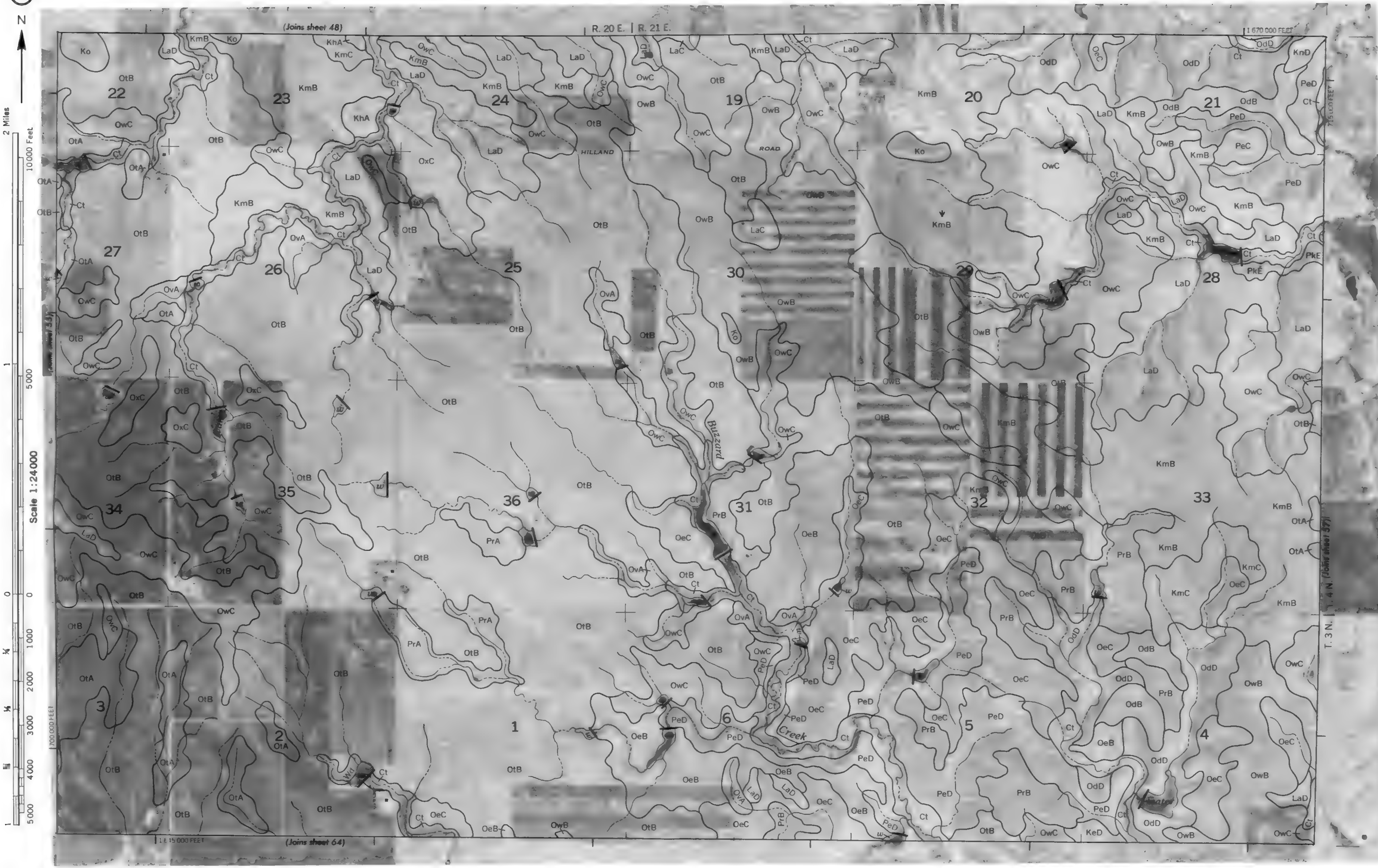
HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 53

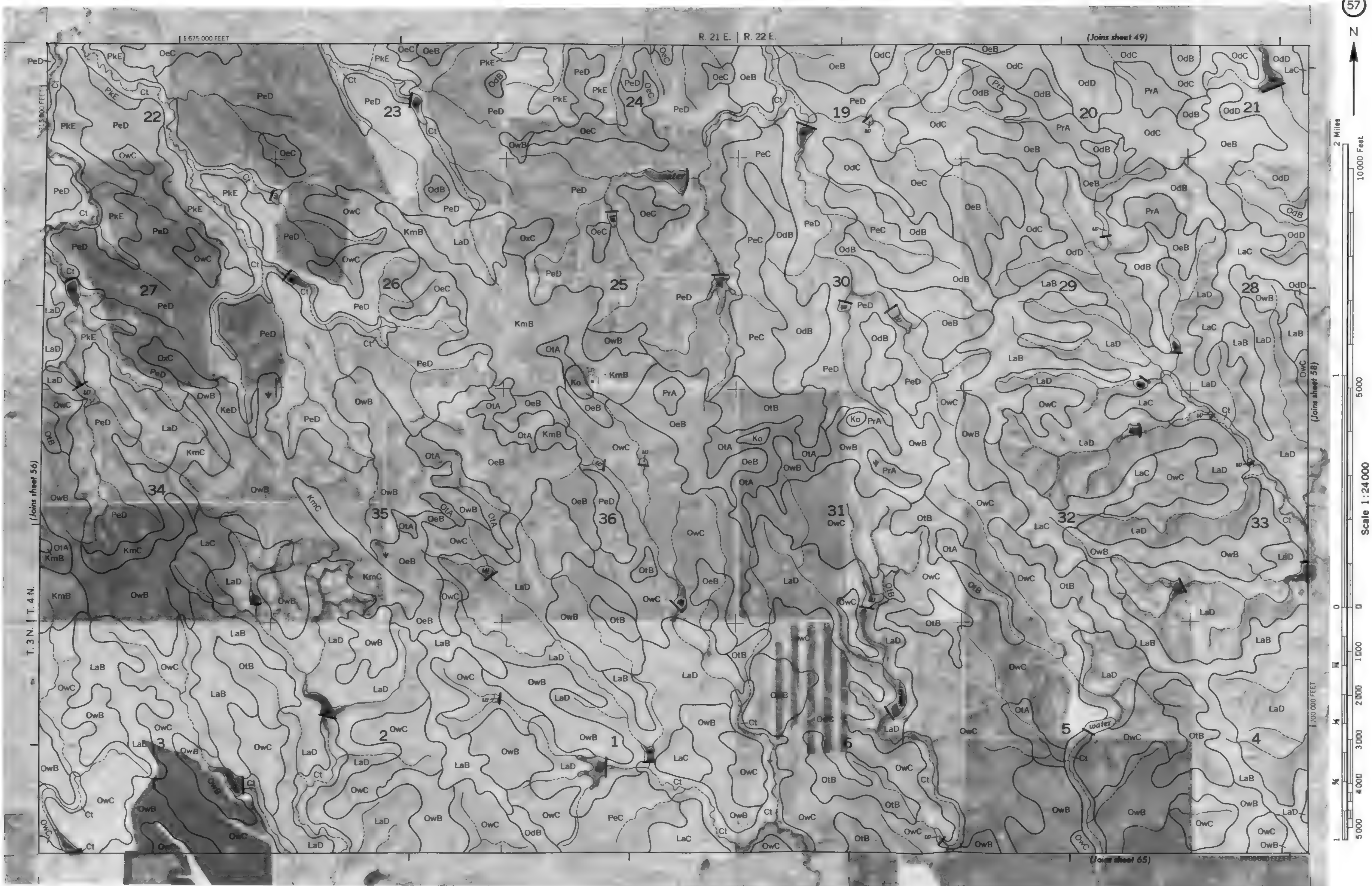
53

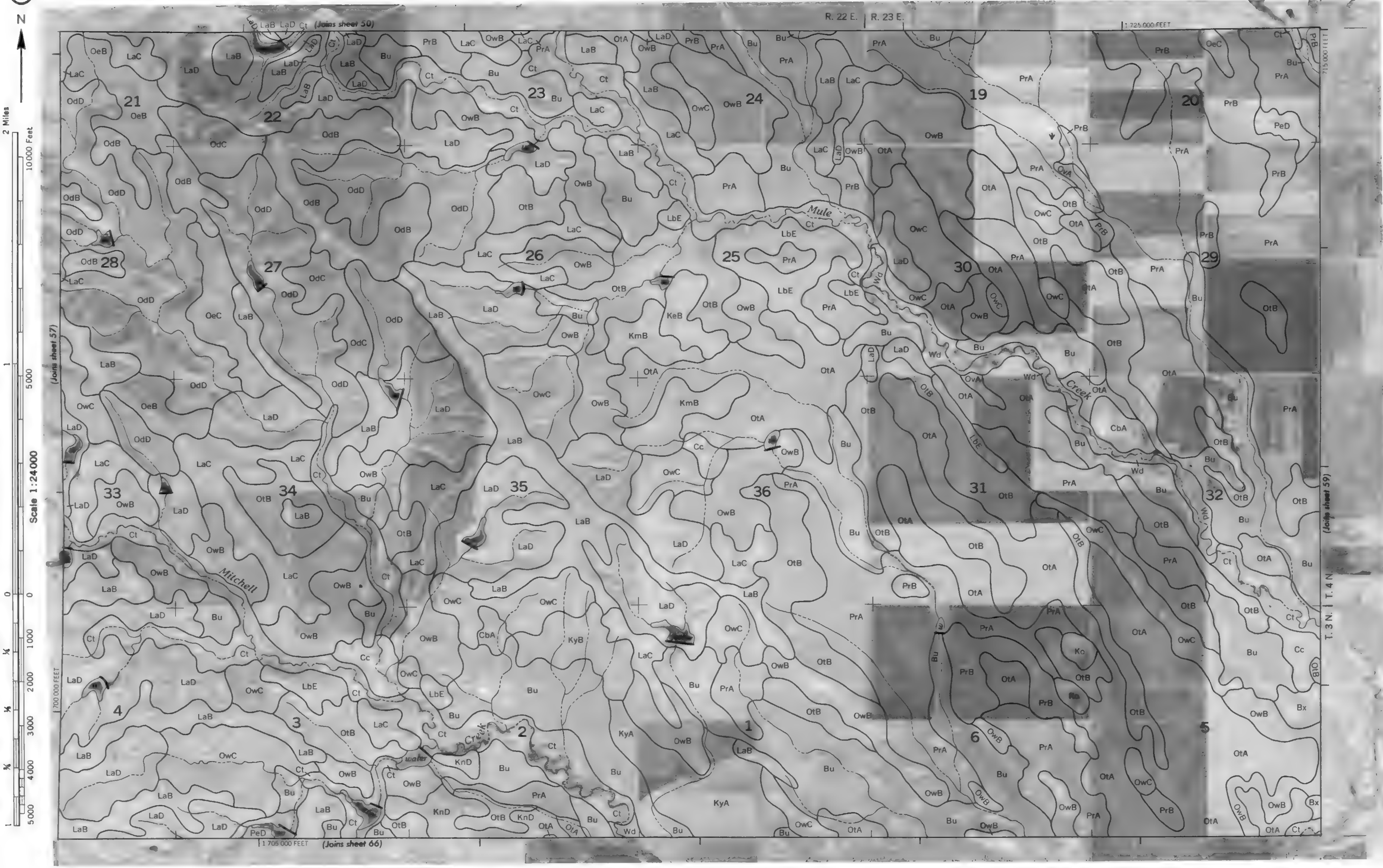


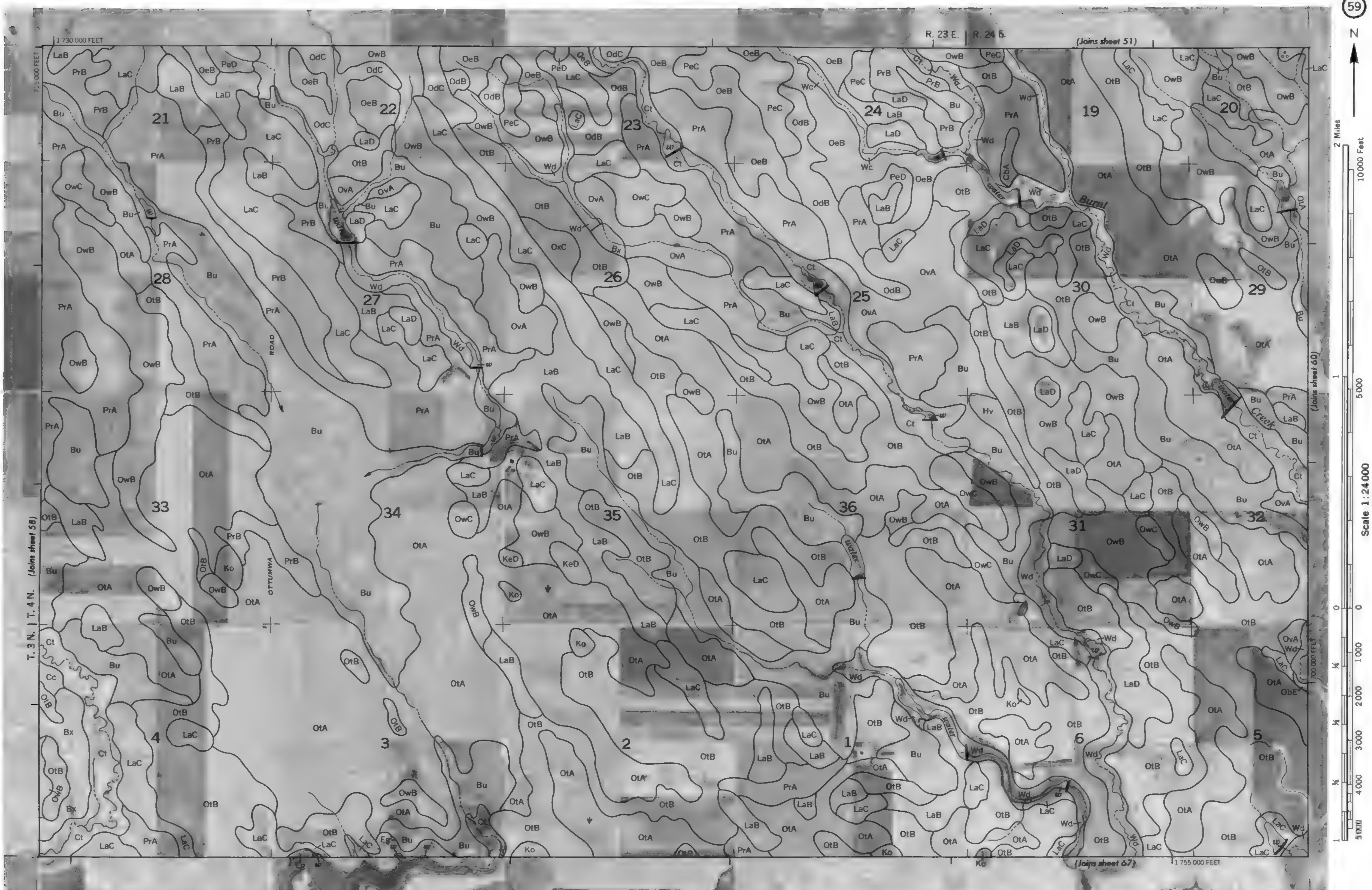

54
N
(Joins sheet 46)
R. 18 E. | R. 19 E.
(Joins sheet 53)
(Joins sheet 55)
(Joins sheet 62)
Hilland
HILLAND ROAD
Bridger Creek
T. 3 N. | T. 4 N.
Scale 1:24000
2 Miles
10000 Feet
1 590 000 FEET
1 610 000 FEET


N
R. 19 E.
R. 20 E.
(Joins sheet 47)
(Joins sheet 54)
(Joins sheet 56)
(Joins sheet 63)
1 615 000 FEET
715 000 FEET
700 000 FEET
1 640 000 FEET
T. 4 N.
T. 3 N.
HILLAND ROAD
HILLAND ROAD
Grindstone Creek
water
2 Miles
10000 Feet
Scale 1:24000
23
24
19
20
21
22
26
25
30
29
28
27
35
36
31
32
33
34
2
1
6
5
4
3
OwC
OvA
OtB
OtA
Ko
Lv
KmB
LaD
LaC
Ct
SdF
OxC
OyC
MaE
CbA
RbD
OwB


N
(Joins sheet 48)
R. 20 E.
R. 21 E.
1 670 000 FEET
HILLAND
ROAD
Buzzard
Creek
Water
(Joins sheet 55)
(Joins sheet 57)
(Joins sheet 64)
T. 4 N.
T. 3 N.
1 615 000 FEET
700 000 FEET
2 Miles
10 000 Feet
Scale 1:24 000
5000
1000
2000
3000
4000
5000
0
1

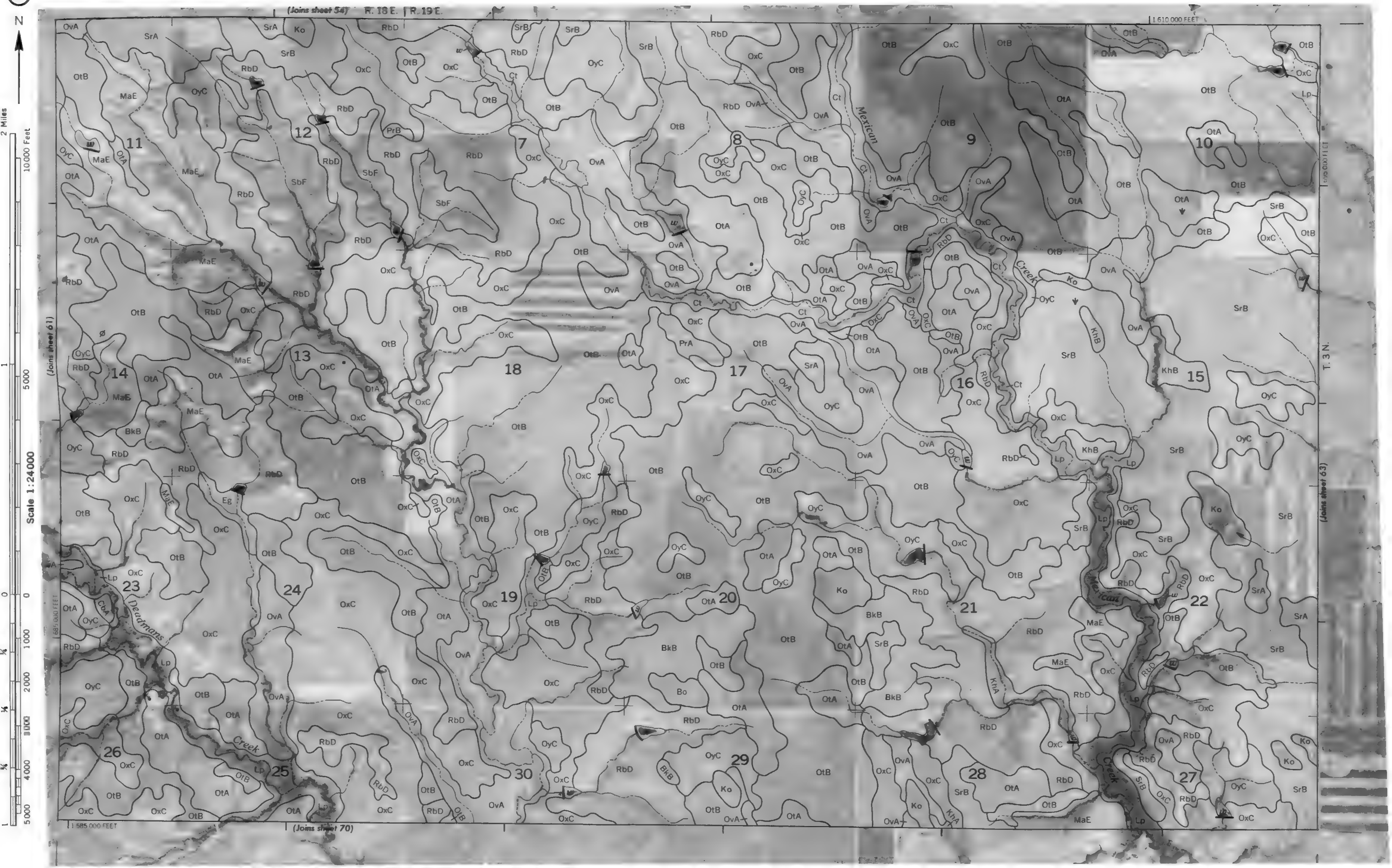

57
N
(Joins sheet 49)
R. 21 E. | R. 22 E.
1 675 000 FEET
(Joins sheet 56)
(Joins sheet 58)
(Joins sheet 65)
T. 3 N. | T. 4 N.
Scale 1:24000
2 Miles
10 000 Feet

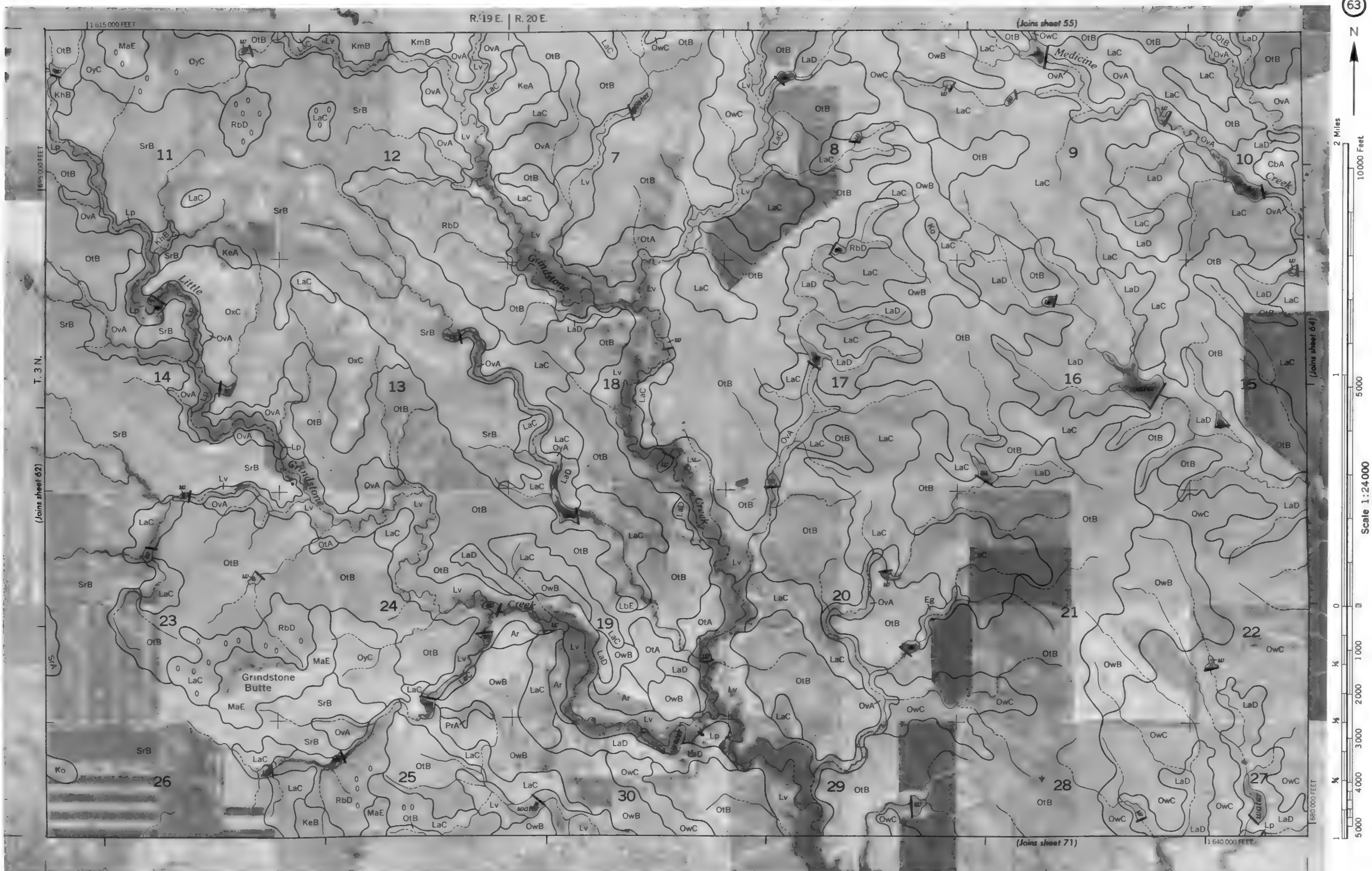

N
2 Miles
10000 Feet
Scale 1:24 000
(Joins sheet 50)
(Joins sheet 57)
(Joins sheet 59)
(Joins sheet 66)
R. 22 E. | R. 23 E.
T. 3 N. | T. 4 N.
1 725 000 FEET
715 000 FEET
700 000 FEET
1 705 000 FEET
Mule Creek
Mitchell Creek
water


59
N
1 730 000 FEET
R. 23 E. | R. 24 E.
(Joins sheet 51)
(Joins sheet 60)
(Joins sheet 67)
(Joins sheet 58)
1 755 000 FEET
T. 3 N. | T. 4 N.
ROAD
OTTUMWA
Burnt
Creek
2 Miles
10000 Feet
Scale 1:24000
21
22
23
24
19
20
28
27
26
25
30
29
33
34
35
36
31
32
4
3
2
1
6
5


(Joins sheet 52)
R. 24 E.
1 785 000 FEET
(Joins sheet 59)
(Joins sheet 68)
1 760 000 FEET
STANLEY COUNTY
T. 4 N.
T. 3 N.
N
2 Miles
10000 Feet
Scale 1:24 000


61
N
R. 18 E.
(Joins sheet 53)
(Joins sheet 62)
(Joins sheet 69)
PENNINGTON COUNTY
PENNINGTON COUNTY
PENNINGTON COUNTY
1 560 000 FEET
695 000 FEET
685 000 FEET
Deadmans
Creek
Dirty
West
Fork
Cr.
Womans
Creek
Scale 1:24000
2 Miles
1
0
10000 Feet
5000
0
1000
2000
3000
4000
5000


N
(Joins sheet 54)
R. 18 E.
R. 19 E.
1 610 000 FEET
(Joins sheet 61)
(Joins sheet 63)
(Joins sheet 70)
1 585 000 FEET
1 685 000 FEET
T. 3 N.
Scale 1:24000
2 Miles
10 000 Feet
Mexican Creek
Deadmans Creek


63
N
R. 19 E. | R. 20 E.
T. 3 N.
1 615 000 FEET
1 640 000 FEET
(Joins sheet 55)
(Joins sheet 62)
(Joins sheet 64)
(Joins sheet 71)
Grindstone Butte
Little Grindstone Creek
Grindstone Creek
Medicine Creek
Scale 1:24000
2 Miles
10000 Feet
5000
0
1000
2000
3000
4000
5000

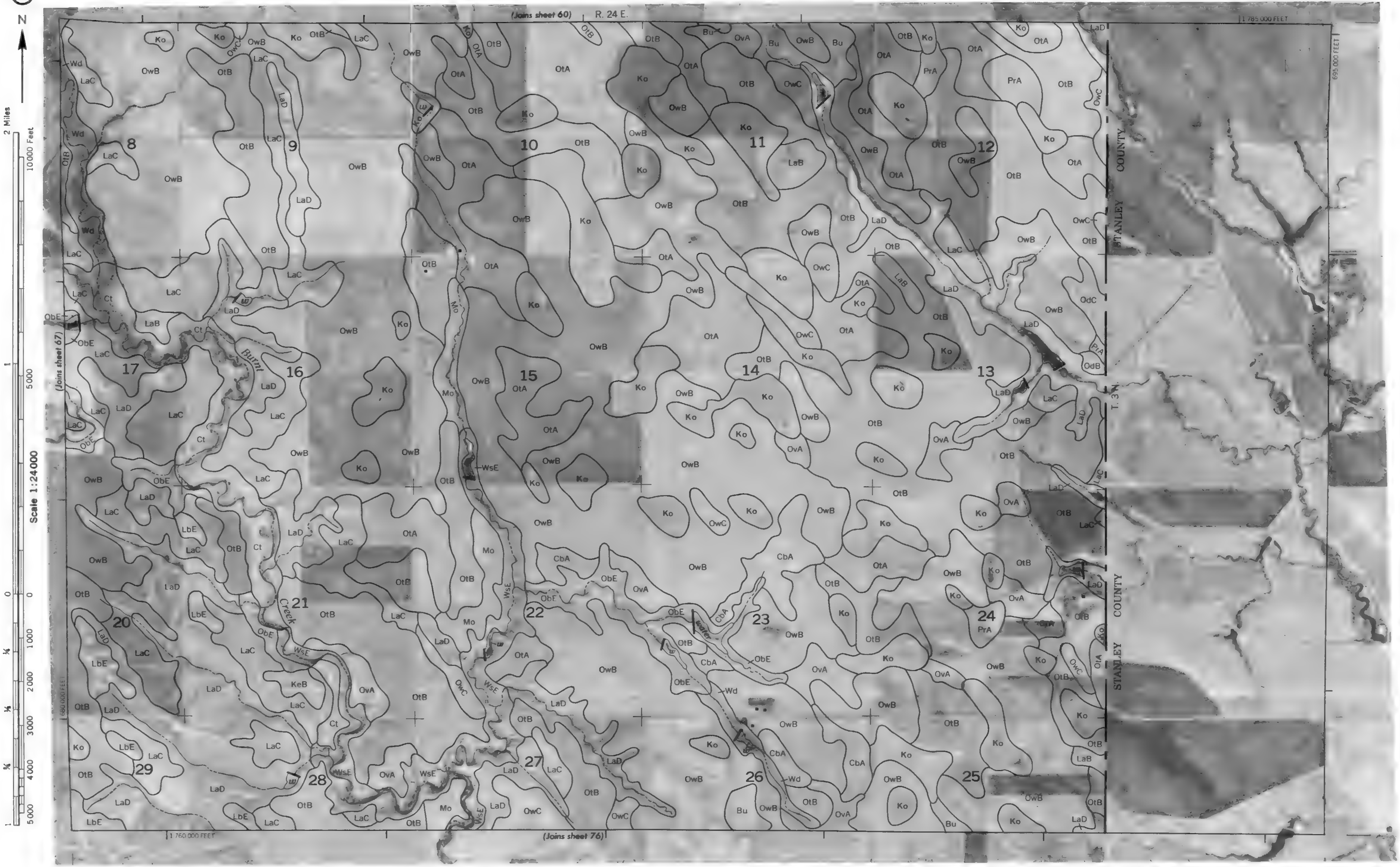
(64)

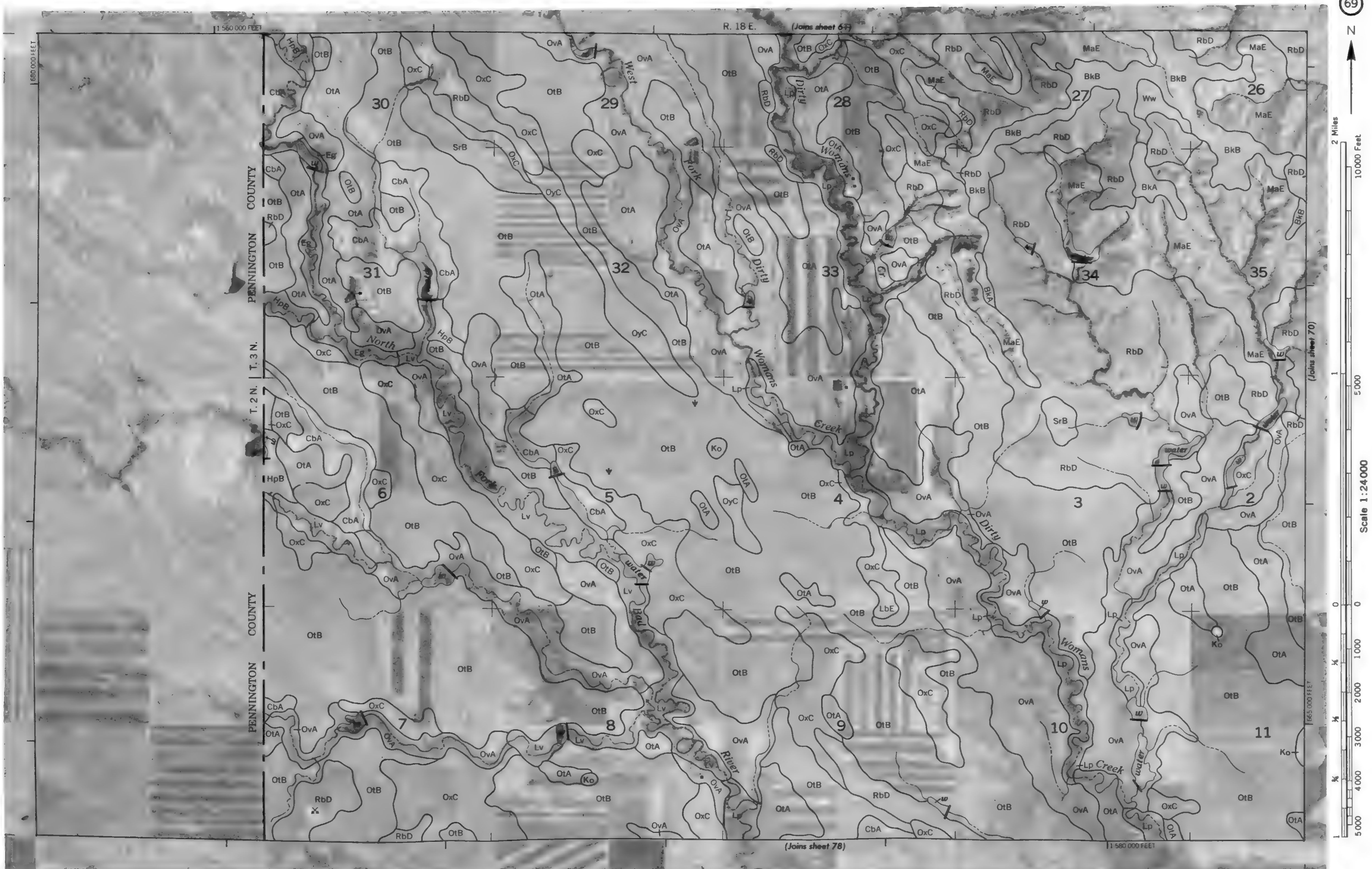

N
2 Miles
10 000 Feet
5000
Scale 1:24 000
(Joins sheet 58)
(Joins sheet 63)
(Joins sheet 72)
(Joins sheet 65)
Medicine
Creek
Buzzard
Creek
water
T. 3 N.
1 645 000 FEET
1 680 000 FEET
695 000 FEET

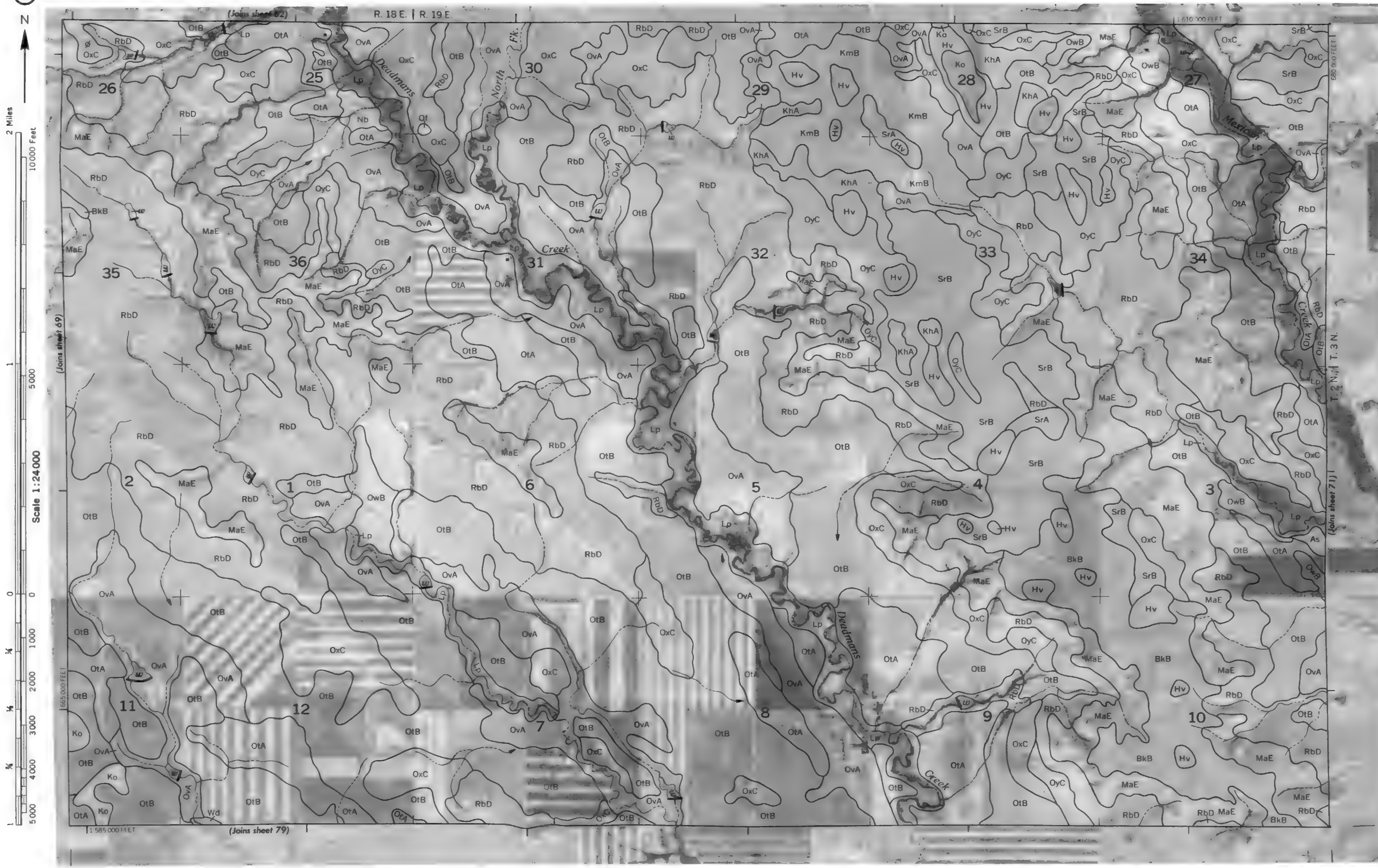

65
N
(Joins sheet 57)
(Joins sheet 64)
(Joins sheet 66)
(Joins sheet 73)
R. 21 E. | R. 22 E.
T. 3 N.
1 675 000 FEET
1 700 000 FEET
695 000 FEET
680 000 FEET
Scale 1:24 000
2 Miles
10000 Feet
Buzzard
Creek

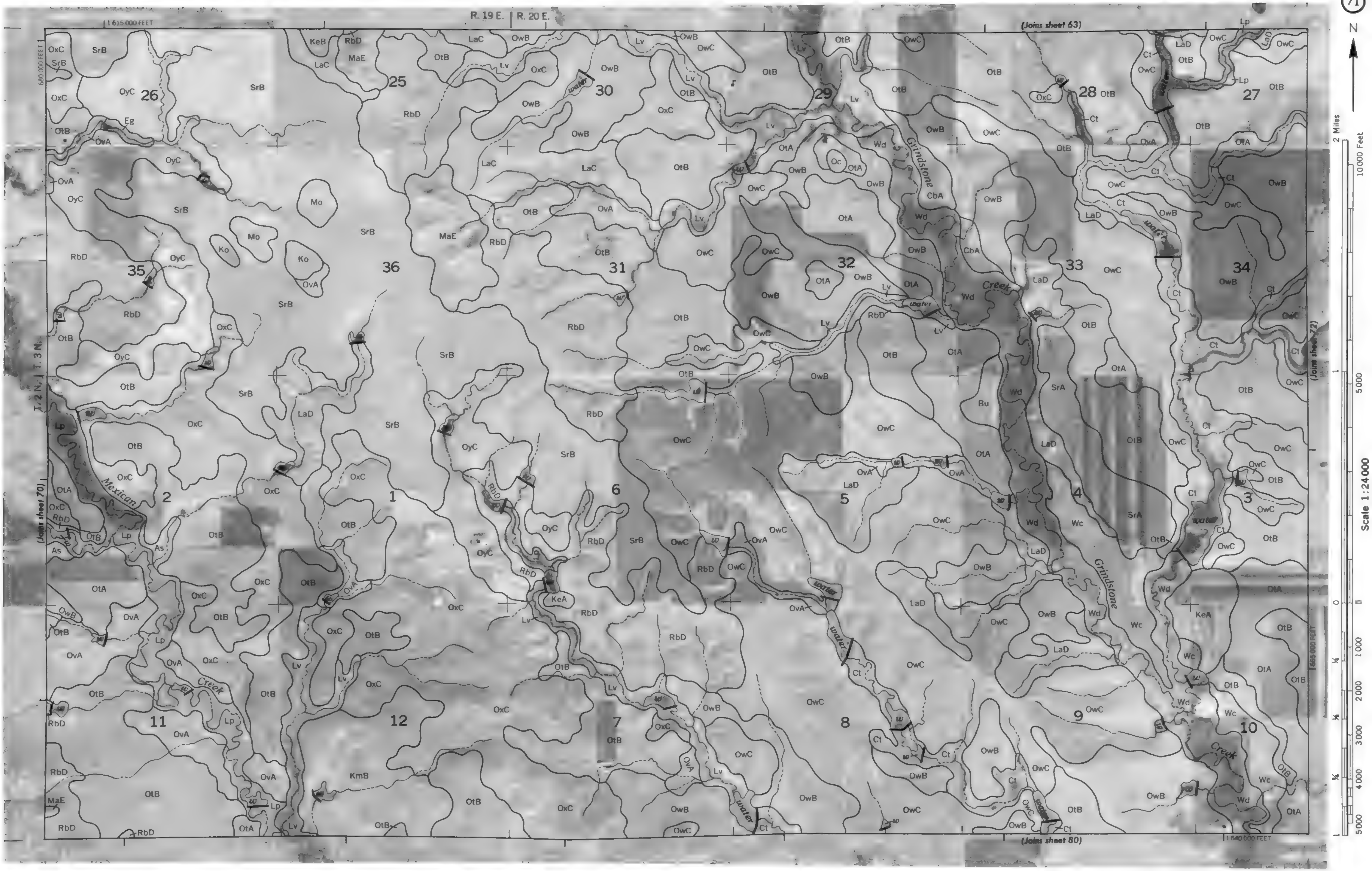
HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 66


67
N
R. 23 E.
R. 24 E.
T. 3 N.
(Joins sheet 59)
(Joins sheet 75)
(Joins sheet 66)
(Joins sheet 68)
1 730 000 FEET
1 755 000 FEET
Ottumwa Lake
Mule Creek
Mitchell Creek
ROAD
OTTUMWA
Scale 1:24000
2 Miles
10000 Feet


N
(Joins sheet 60)
R. 24 E.
(Joins sheet 67)
(Joins sheet 76)
Scale 1:24 000
2 Miles
10 000 Feet
1 785 000 FEET
695 000 FEET
1 760 000 FEET
660 000 FEET
STANLEY COUNTY
STANLEY COUNTY
T. 3 N.
Burnt Creek
Ko
OwB
OtB
OtA
LaC
LaD
LaB
Wd
Ct
ObE
OwC
OvA
CbA
Mo
WsE
PrA
Bu
LbE
KeB
OdC
OdB
water


69
N
R. 18 E.
(Joins sheet 61)
(Joins sheet 70)
(Joins sheet 78)
1 560 000 FEET
1 580 000 FEET
680 000 FEET
665 000 FEET
PENNINGTON COUNTY
T. 3 N.
T. 2 N.
North Fork
West Fork
Dirty Womans Creek
Bad River
Scale 1:24 000
2 Miles
10 000 Feet
1
5000
0
1000
2000
3000
4000
5000

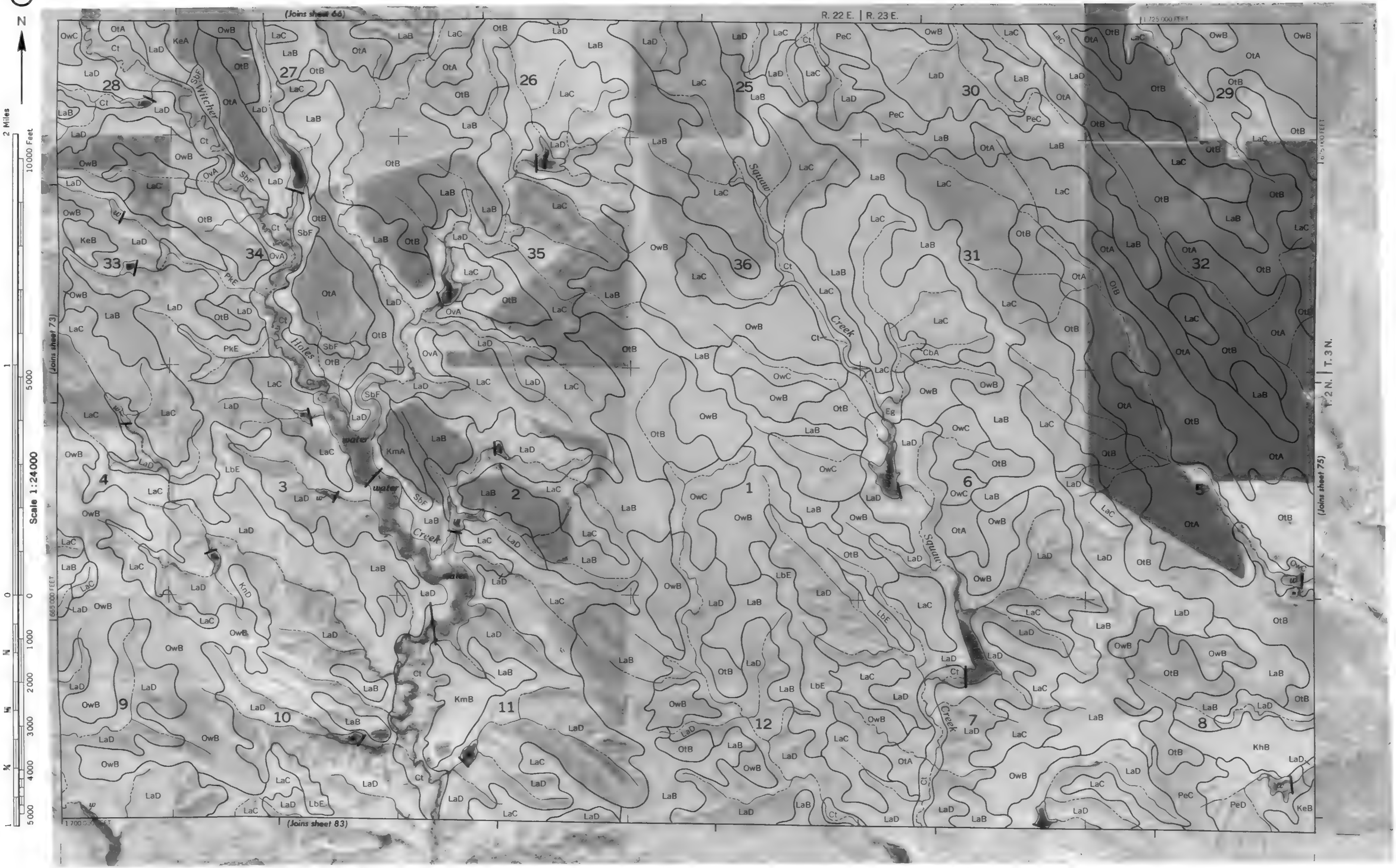

N
2 Miles
10000 Feet
5000
0
Scale 1:24 000
(Joins sheet 62)
R. 18 E. | R. 19 E.
(Joins sheet 69)
(Joins sheet 71)
(Joins sheet 79)
T. 2 N. | T. 3 N.
1 585 000 FEET
1 610 000 FEET
680 000 FEET
665 000 FEET
Deadmans Creek
North Fk.
Mexican Creek
26
25
30
29
28
27
35
36
31
32
33
34
2
1
6
5
4
3
11
12
7
8
9
10

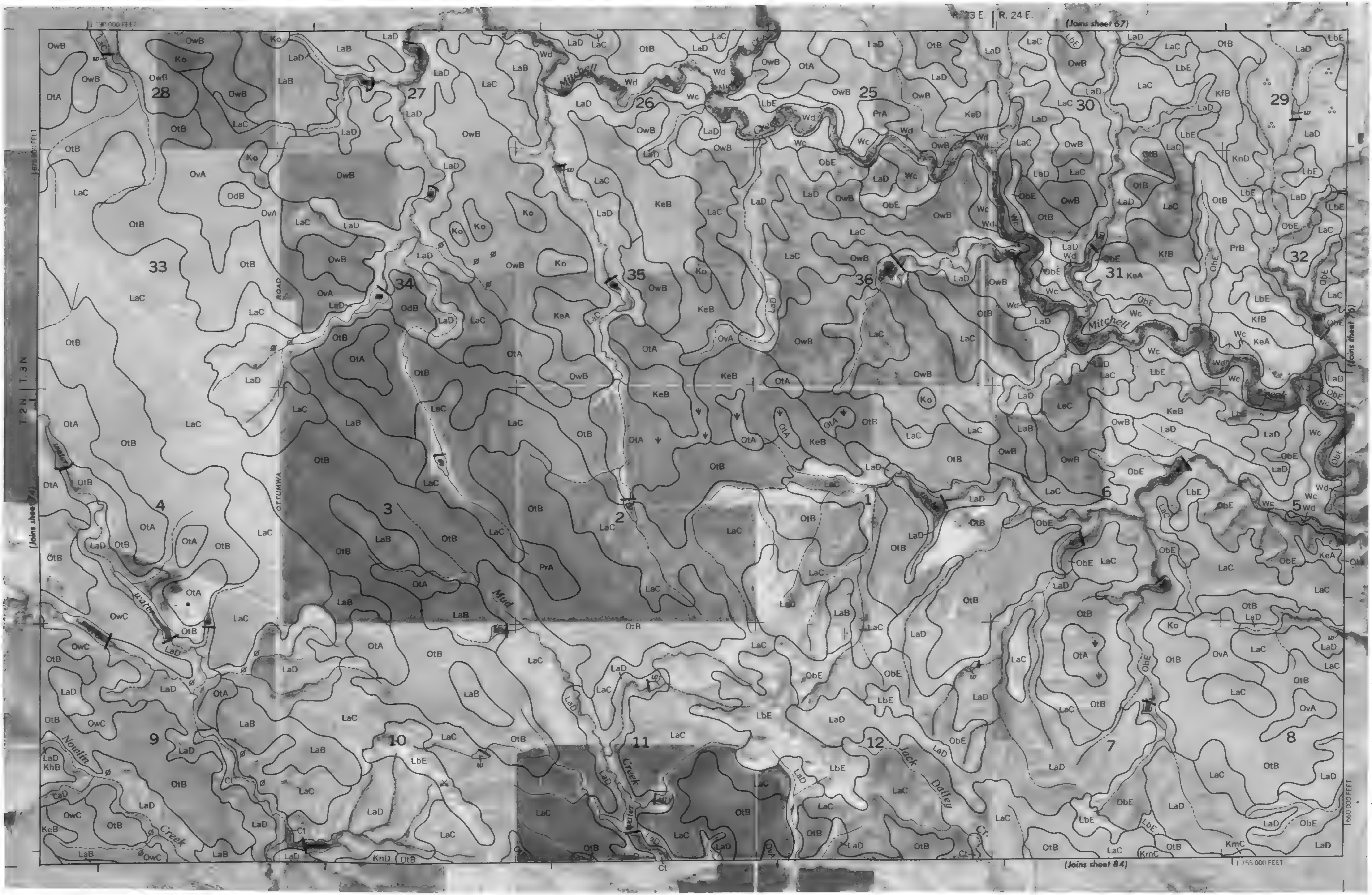

R. 19 E.
R. 20 E.
1 615 000 FEET
680 000 FEET
(Joins sheet 63)
(Joins sheet 70)
(Joins sheet 72)
(Joins sheet 80)
1 640 000 FEET
665 000 FEET
T. 3 N.
T. 2 N.
N
Mexican Creek
Grindstone Creek
water
25
26
27
28
29
30
31
32
33
34
35
36
1
2
3
4
5
6
7
8
9
10
11
12
Scale 1:24 000
2 Miles
1
0
10000 Feet
5000
0
5000

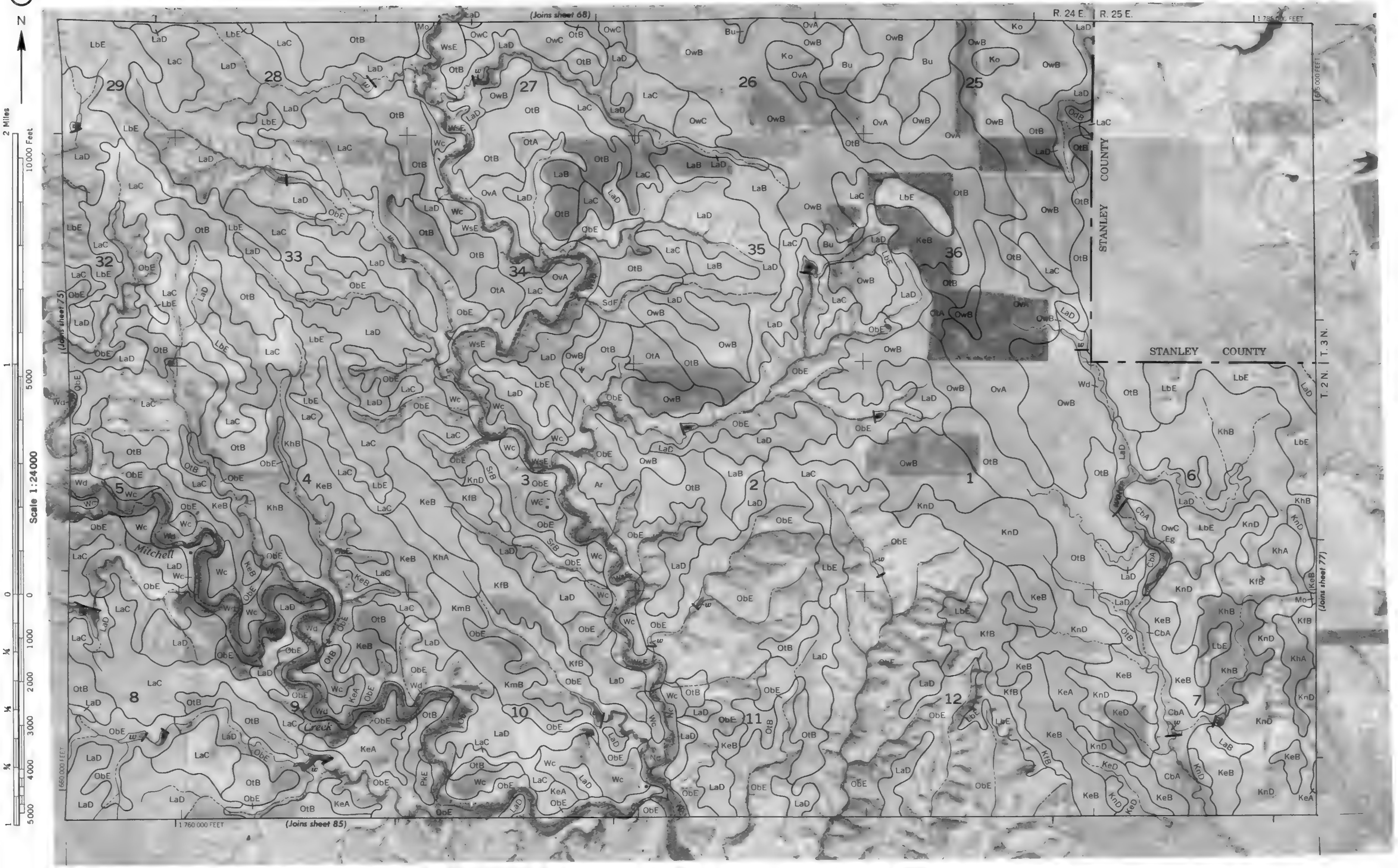
HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 72

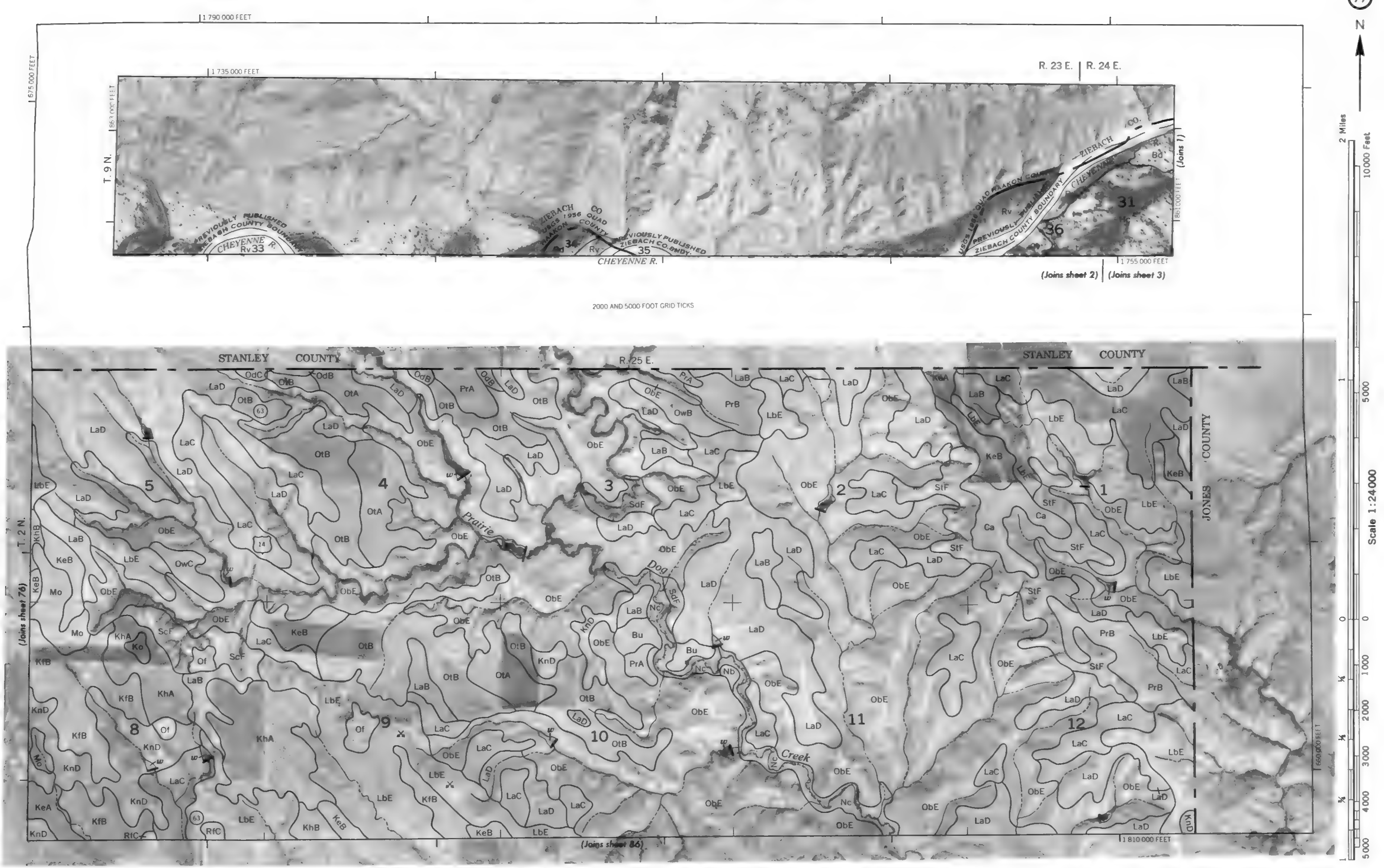

73
N
(Joins sheet 65)
R. 21 E. | R. 22 E.
1 675 000 FEET
675 000 FEET
T. 2 N. | T. 3 N.
(Joins sheet 72)
(Joins sheet 74)
(Joins sheet 82)
1 700 000 FEET
665 000 FEET
Buzzard Creek
Scale 1:24 000
2 Miles
10000 Feet
5000
1000
2000
3000
0
1
27
26
25
30
29
28
34
35
36
31
32
33
3
2
1
6
5
4
10
11
12
7
8
9

HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 74

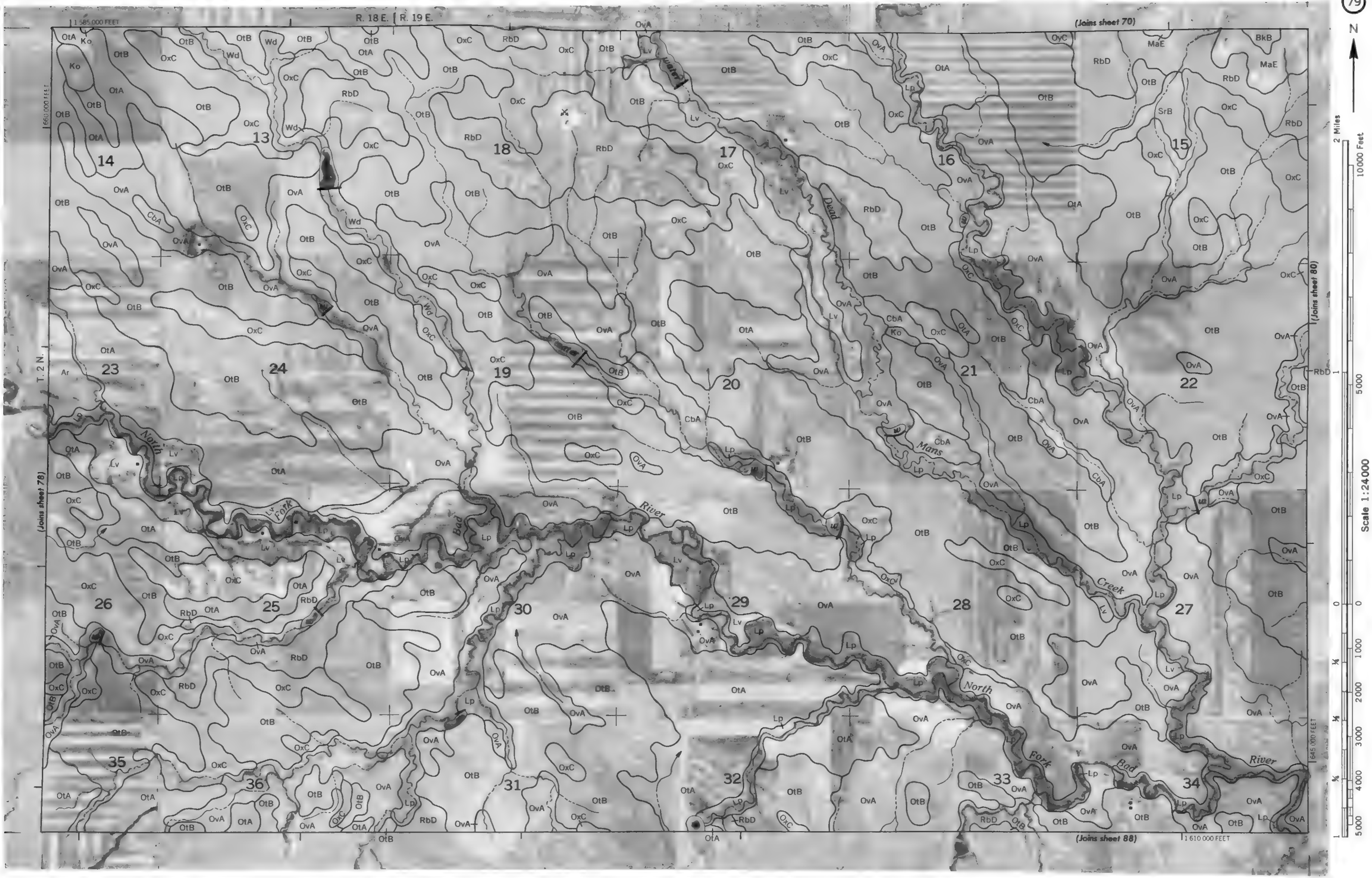


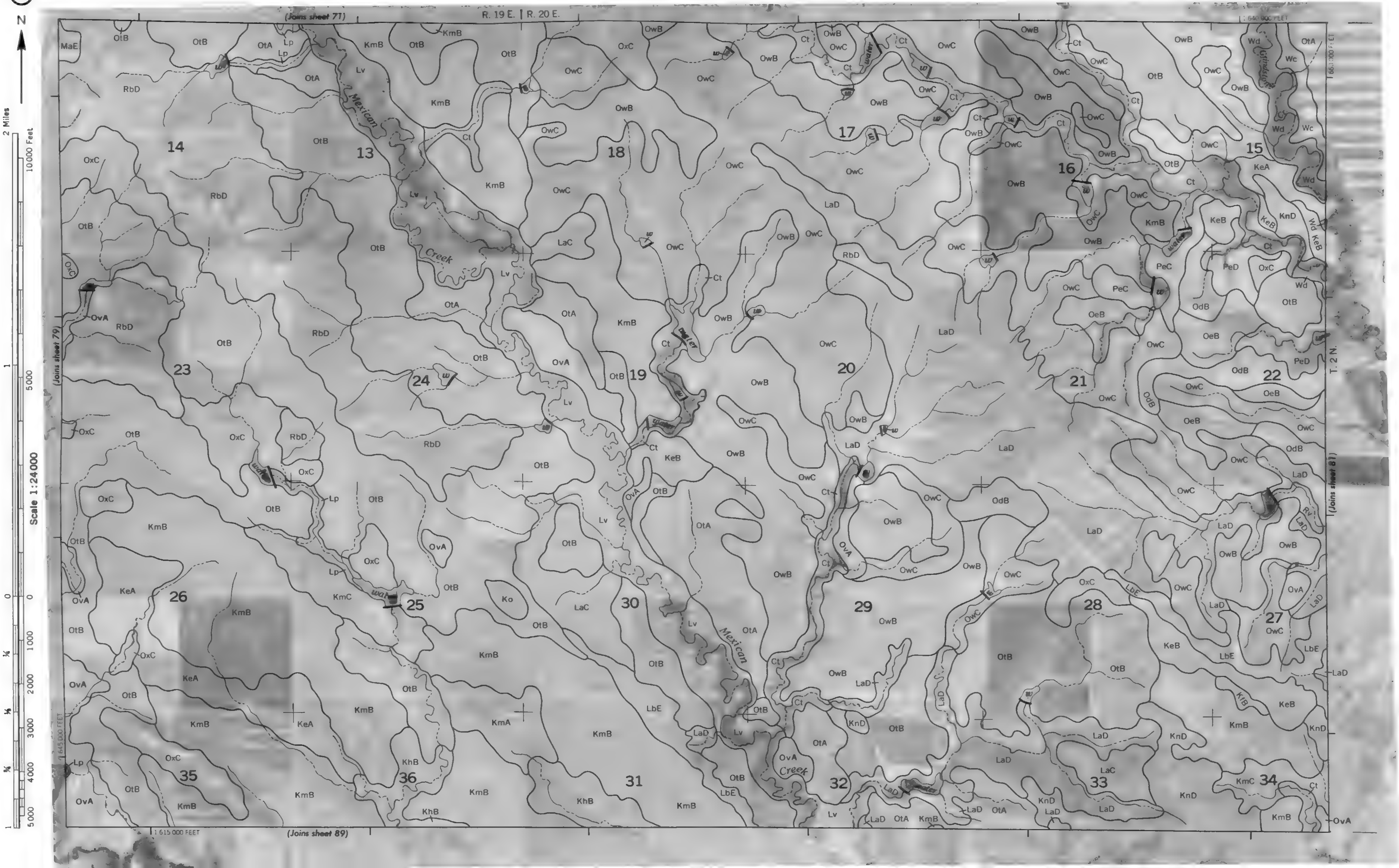

R. 23 E.
R. 24 E.
(Joins sheet 67)
(Joins sheet 84)
(Joins sheet 74)
(Joins sheet 76)
T. 3 N.
T. 2 N.
N
Scale 1:24000
2 Miles
10000 Feet
1 755 000 FEET
660 000 FEET
675 000 FEET
OTTUMWA ROAD
Mitchell Creek
Mud
Jack Dailey Cr.
Noulin Creek
Creek

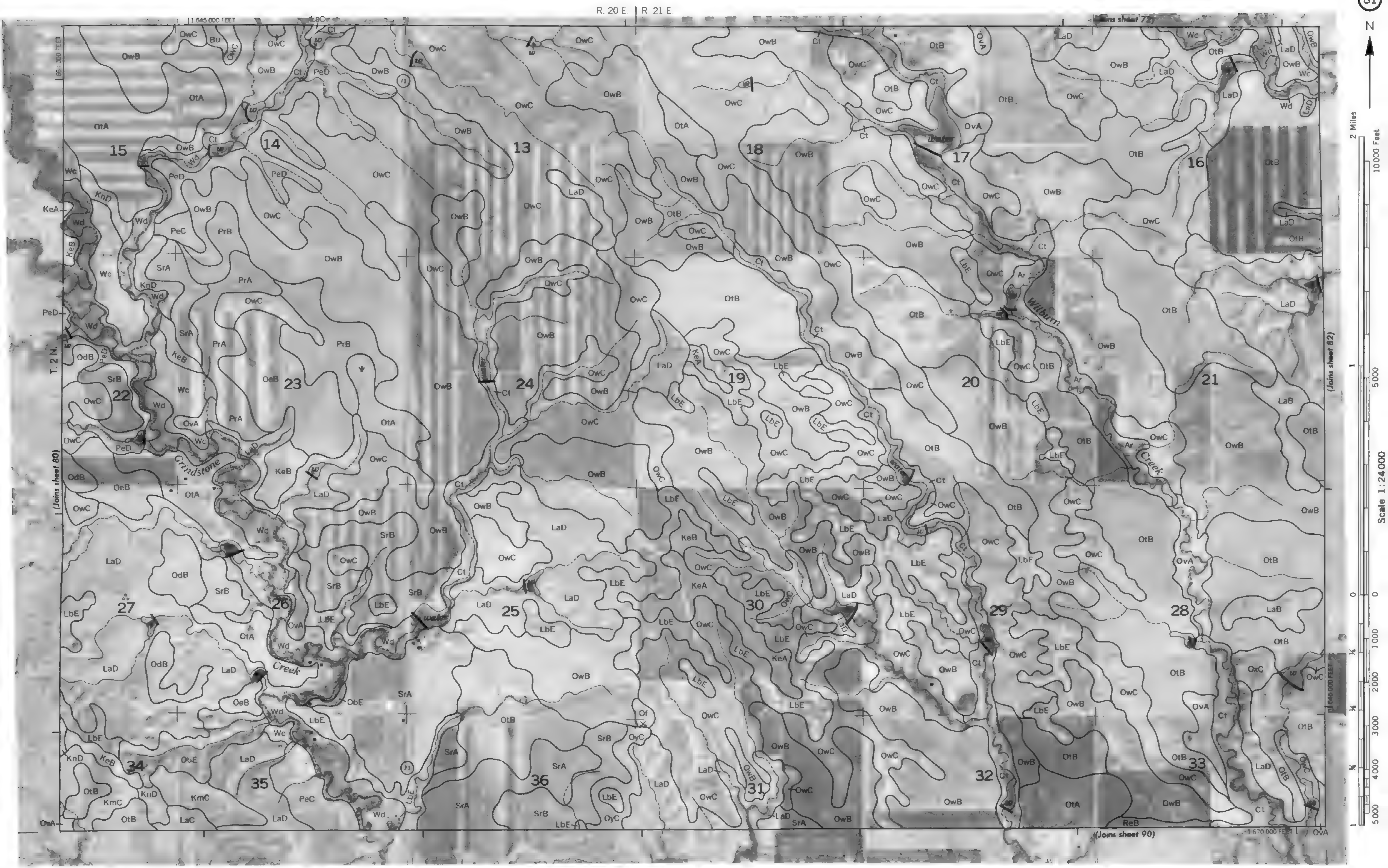

(Joins sheet 68)
R. 24 E.
R. 25 E.
1 785 000 FEET
675 000 FEET
STANLEY COUNTY
STANLEY COUNTY
T. 3 N.
T. 2 N.
(Joins sheet 75)
(Joins sheet 77)
(Joins sheet 85)
1 760 000 FEET
660 000 FEET
N
2 Miles
10 000 Feet
Scale 1:24 000
Mitchell
Creek
29
28
27
26
25
32
33
34
35
36
5
4
3
2
1
6
8
9
10
11
12
7


77
N
1 790 000 FEET
675 000 FEET
1 735 000 FEET
R. 23 E.
R. 24 E.
T. 9 N.
PREVIOUSLY PUBLISHED ZIEBACH COUNTY BOUNDARY
CHEYENNE R.
ZIEBACH CO.
HAAKON COUNTY
USGS 1956 QUAD
PREVIOUSLY PUBLISHED ZIEBACH CO. BNDY.
CHEYENNE R.
1 755 000 FEET
(Joins sheet 2)
(Joins sheet 3)
(Joins 1)
2000 AND 5000 FOOT GRID TICKS
STANLEY COUNTY
R. 25 E.
STANLEY COUNTY
JONES COUNTY
T. 2 N.
(Joins sheet 76)
Prairie
Dog
Creek
(Joins sheet 86)
1 810 000 FEET
660 000 FEET
2 Miles
10 000 Feet
Scale 1:24 000

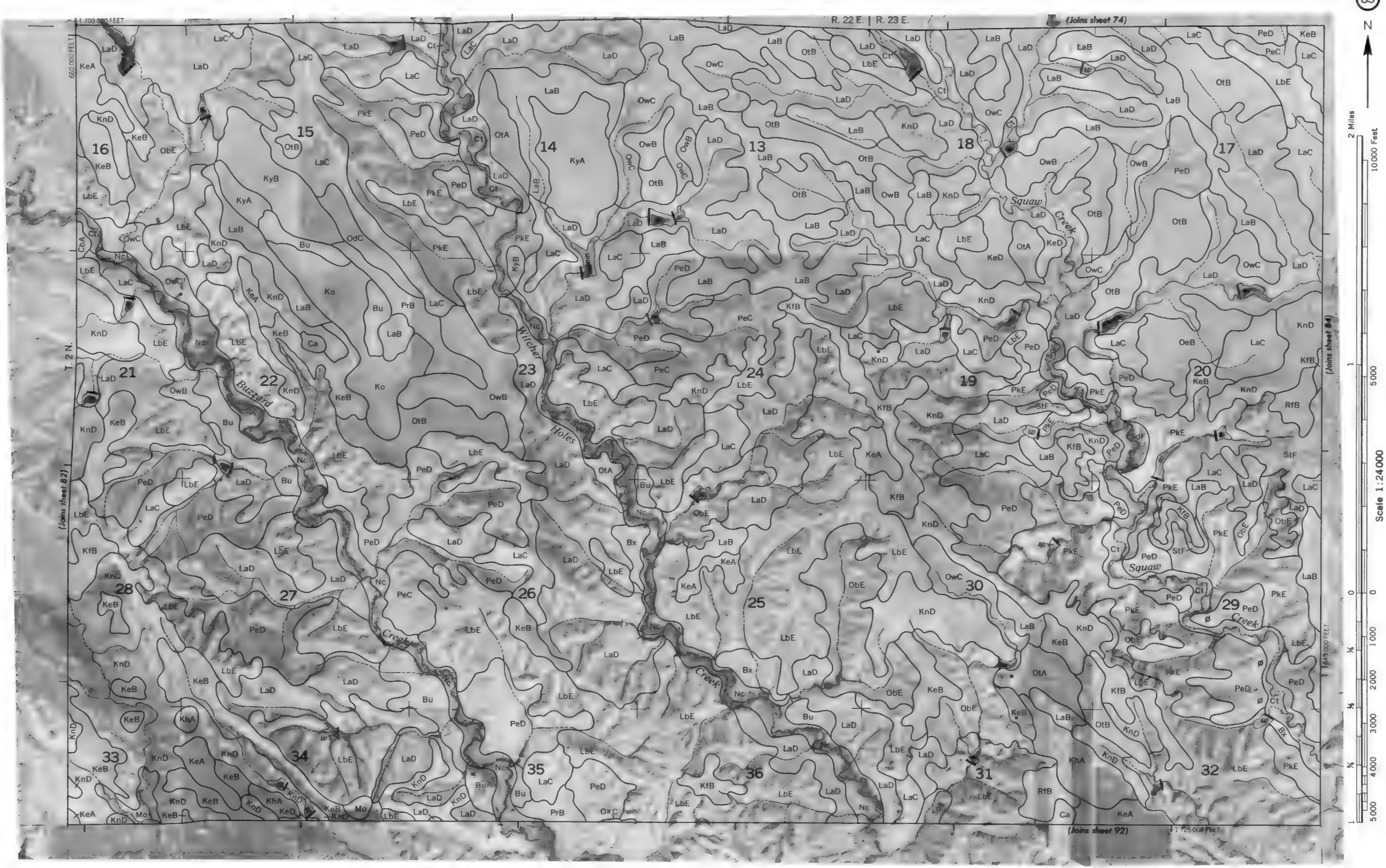

78
N
2 Miles
10000 Feet
1
5000
Scale 1:24 000
0
1000
2000
3000
4000
5000
(Joins sheet 69)
R. 18 E.
1 560 000 FEET
660 000 FEET
T. 2 N.
(Joins sheet 79)
(Joins sheet 87)
1 560 000 FEET
645 000 FEET
PENNINGTON COUNTY
North Fork
Creek
Poeno
Bad
River
14
15
16
17
18
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
OtB
OtA
OvA
OxC
OwB
OyC
RbD
CbA
Lp
Lv
Ar
Eg
Hv
Ww
SrB
MaE
BkB
Bo
Hb


1 585 000 FEET
R. 18 E. | R. 19 E.
(Joins sheet 70)
(Joins sheet 80)
(Joins sheet 78)
(Joins sheet 88)
T. 2 N.
660 000 FEET
645 000 FEET
1 610 000 FEET
N
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
North Fork Bad River
Bad River
Dead Mans Creek
OtA
OtB
OxC
OvA
RbD
Wd
Ko
CbA
Lv
Lp
Ar
MaE
BkB
SrB
OyC
2 Miles
10000 Feet
Scale 1:24000
5000
1000
2000
3000
4000
0
1

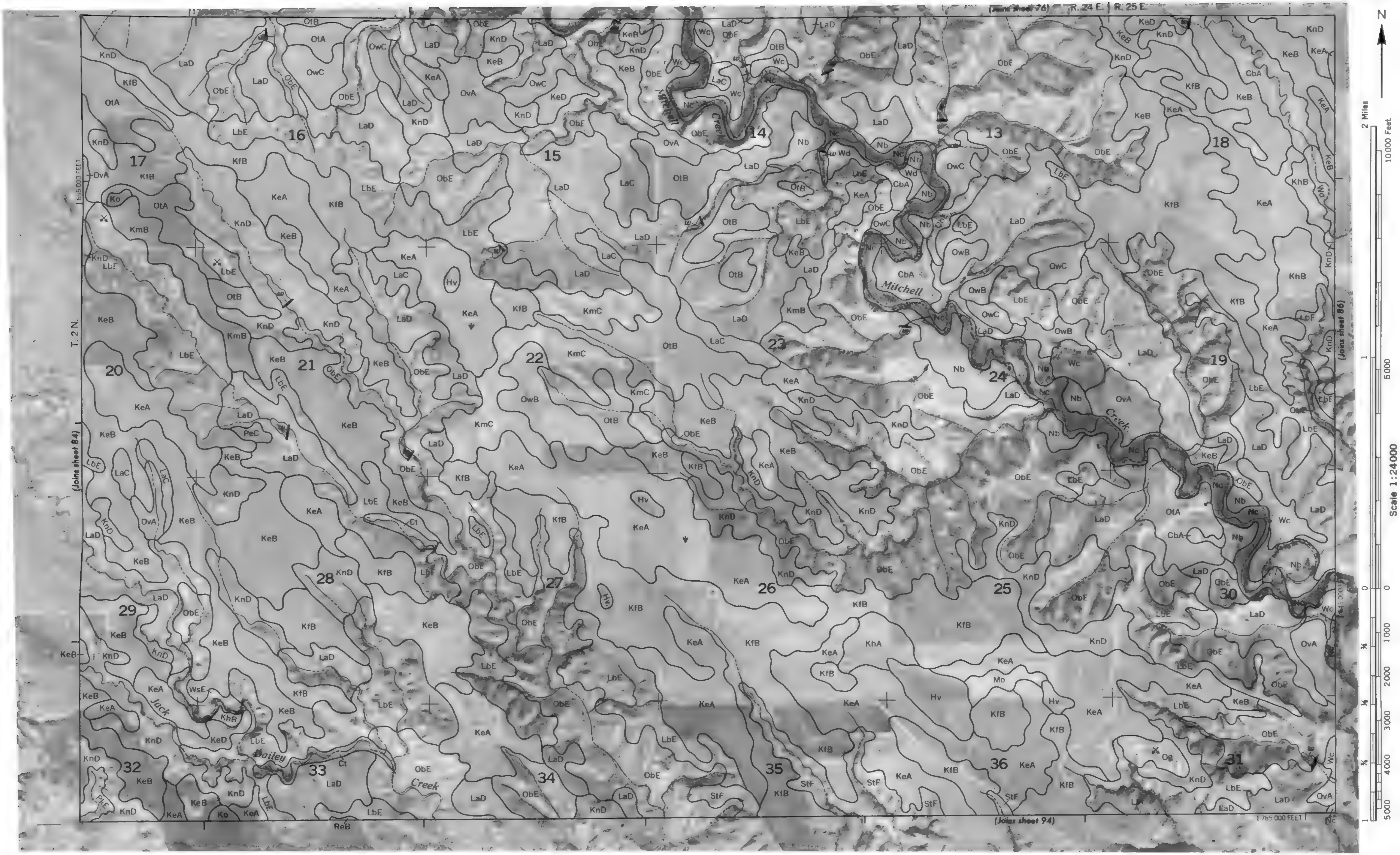

N
2 Miles
10000 Feet
Scale 1:24000
(Joins sheet 71)
R. 19 E.
R. 20 E.
(Joins sheet 79)
(Joins sheet 81)
(Joins sheet 89)
T. 2 N.
1 615 000 FEET
645 000 FEET
Mexican
Creek
Mexican
Creek
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36

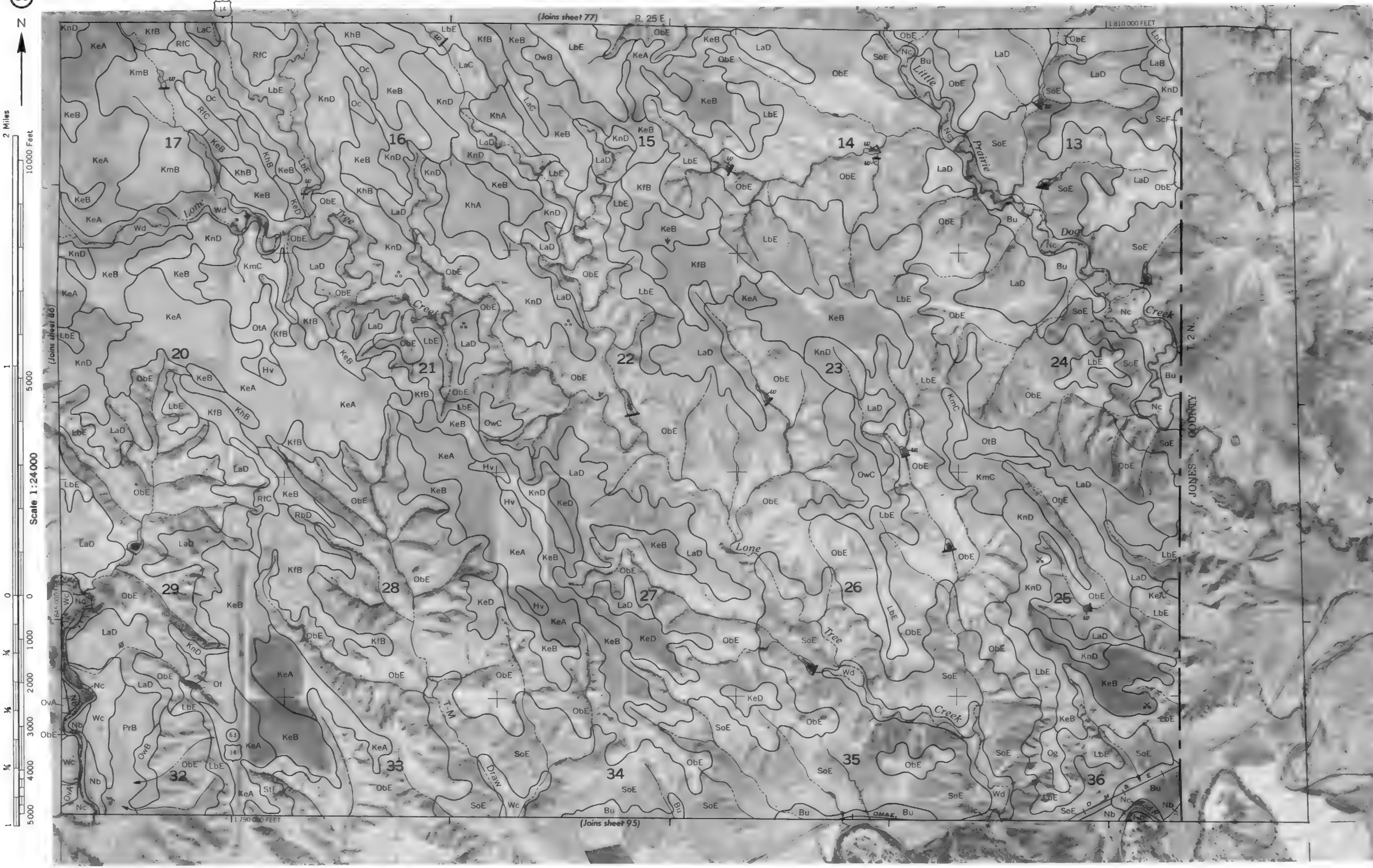

R. 20 E. | R. 21 E.
1 645 000 FEET
(Joins sheet 72)
(Joins sheet 80)
(Joins sheet 82)
(Joins sheet 90)
1 670 000 FEET
T. 2 N.
N
2 Miles
10 000 Feet
Scale 1:24 000
Grindstone
Creek
Wilburn
Creek
water
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36

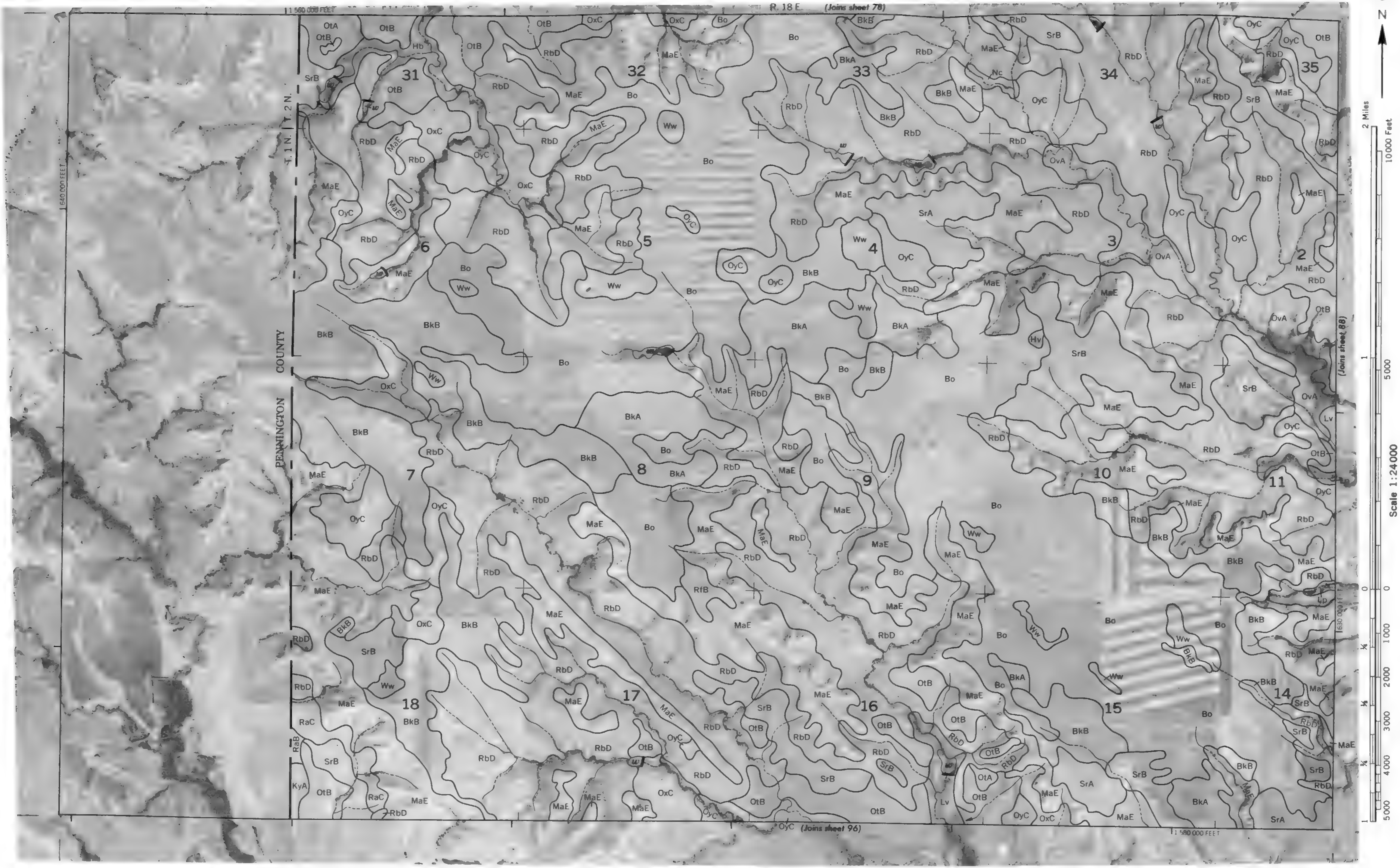
HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 82


83
N
(Joins sheet 74)
R. 22 E. | R. 23 E.
1 700 000 FEET
660 000 FEET
T. 2 N.
(Joins sheet 82)
(Joins sheet 84)
(Joins sheet 92)
1 725 000 FEET
649 000 FEET
Squaw Creek
Witcher Holes
Buzzard Creek
Scale 1:24 000
2 Miles
10 000 Feet
1
5000
0
1000
2000
3000
4000
5000

HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 84

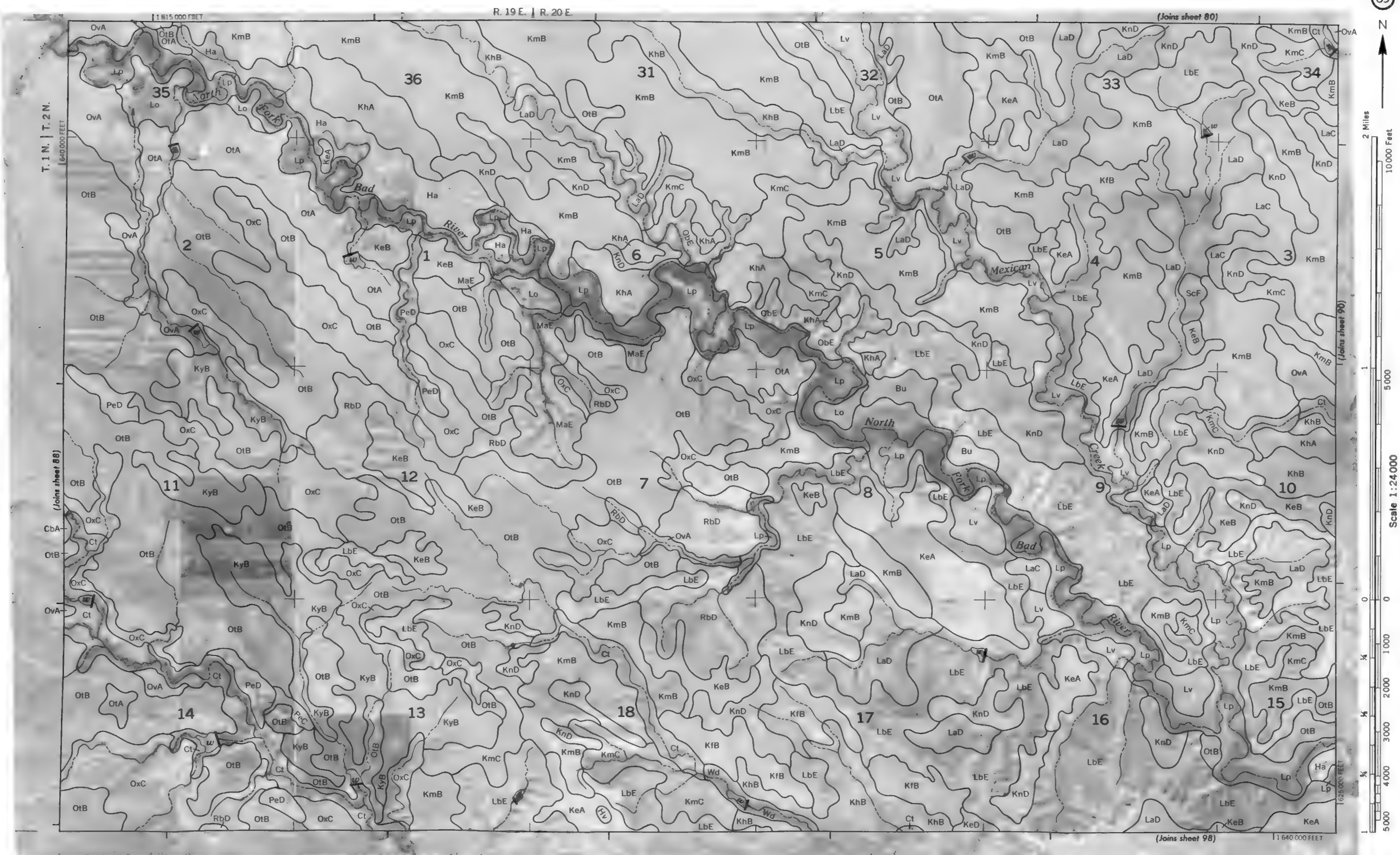

(Joins sheet 76)
R. 24 E.
R. 25 E.
T. 2 N.
(Joins sheet 84)
(Joins sheet 86)
(Joins sheet 94)
Mitchell Creek
Mitchell
Creek
Jack
Dailey
Creek
1 785 000 FEET
N
2 Miles
10 000 Feet
Scale 1:24000

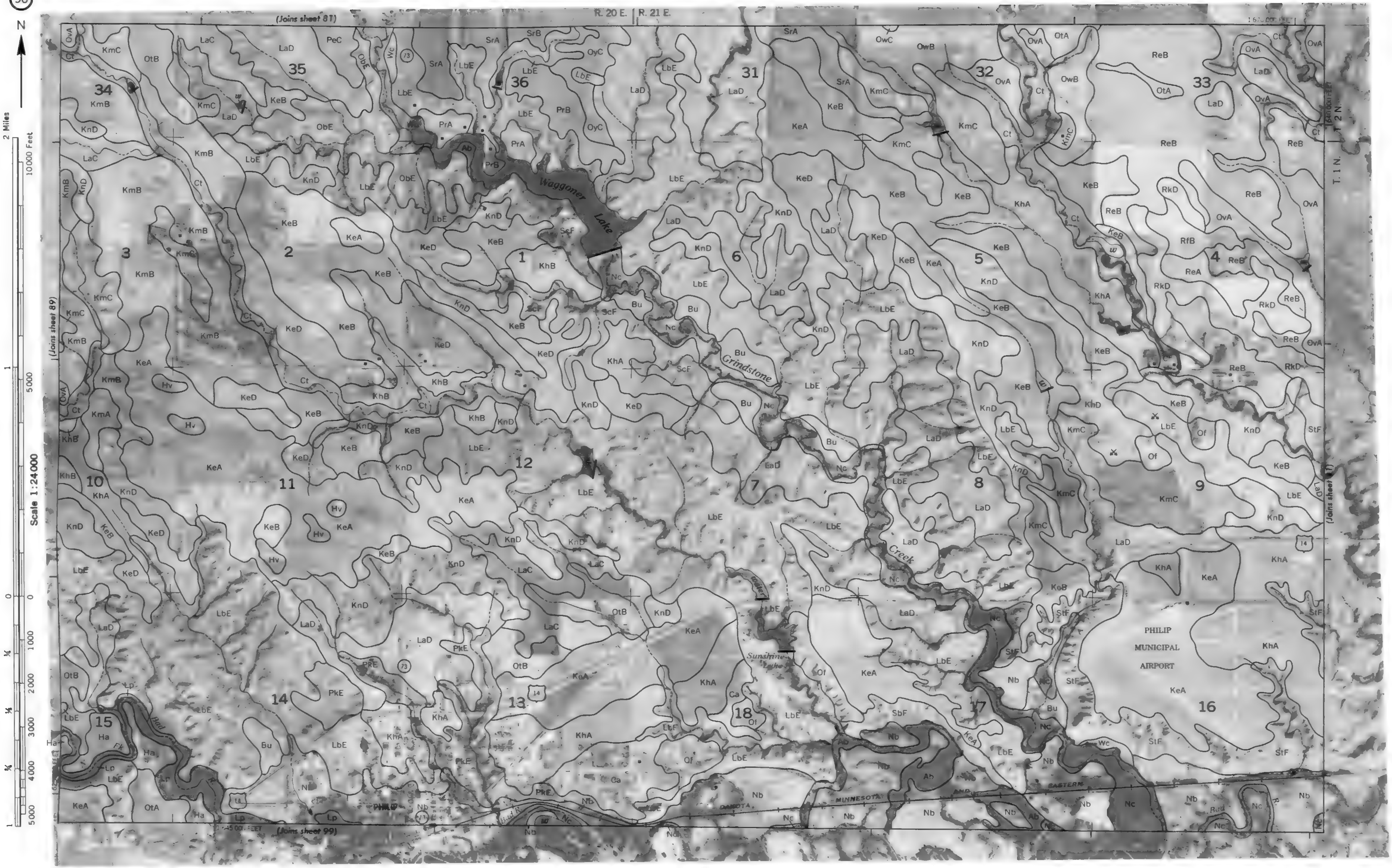

N
(Joins sheet 77)
R. 25 E.
1 810 000 FEET
(Joins sheet 86)
(Joins sheet 95)
1 790 000 FEET
T. 2 N.
JONES COUNTY
Scale 1:24 000
2 Miles
10 000 Feet
Lone Tree Creek
Little Prairie Dog Creek
T. M. Draw
Bad R.
13
14
15
16
17
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36


R. 18 E.
(Joins sheet 78)
(Joins sheet 88)
(Joins sheet 96)
1 560 000 FEET
1 580 000 FEET
540 000 FEET
630 000 FEET
T. 2 N.
T. 1 N.
PENNINGTON COUNTY
31
32
33
34
35
6
5
4
3
2
7
8
9
10
11
18
17
16
15
14
N
2 Miles
10000 Feet
Scale 1:24000

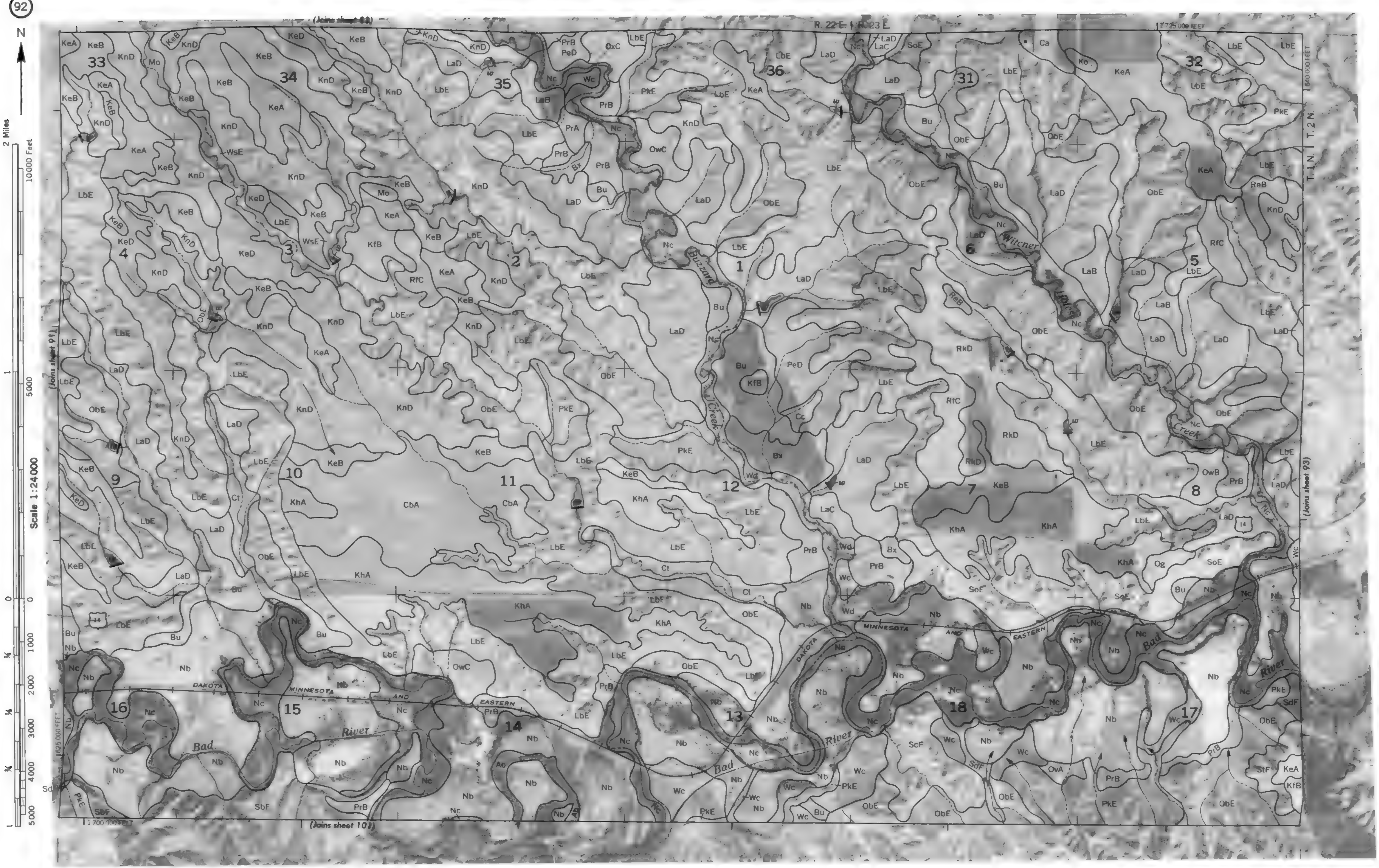
HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 88

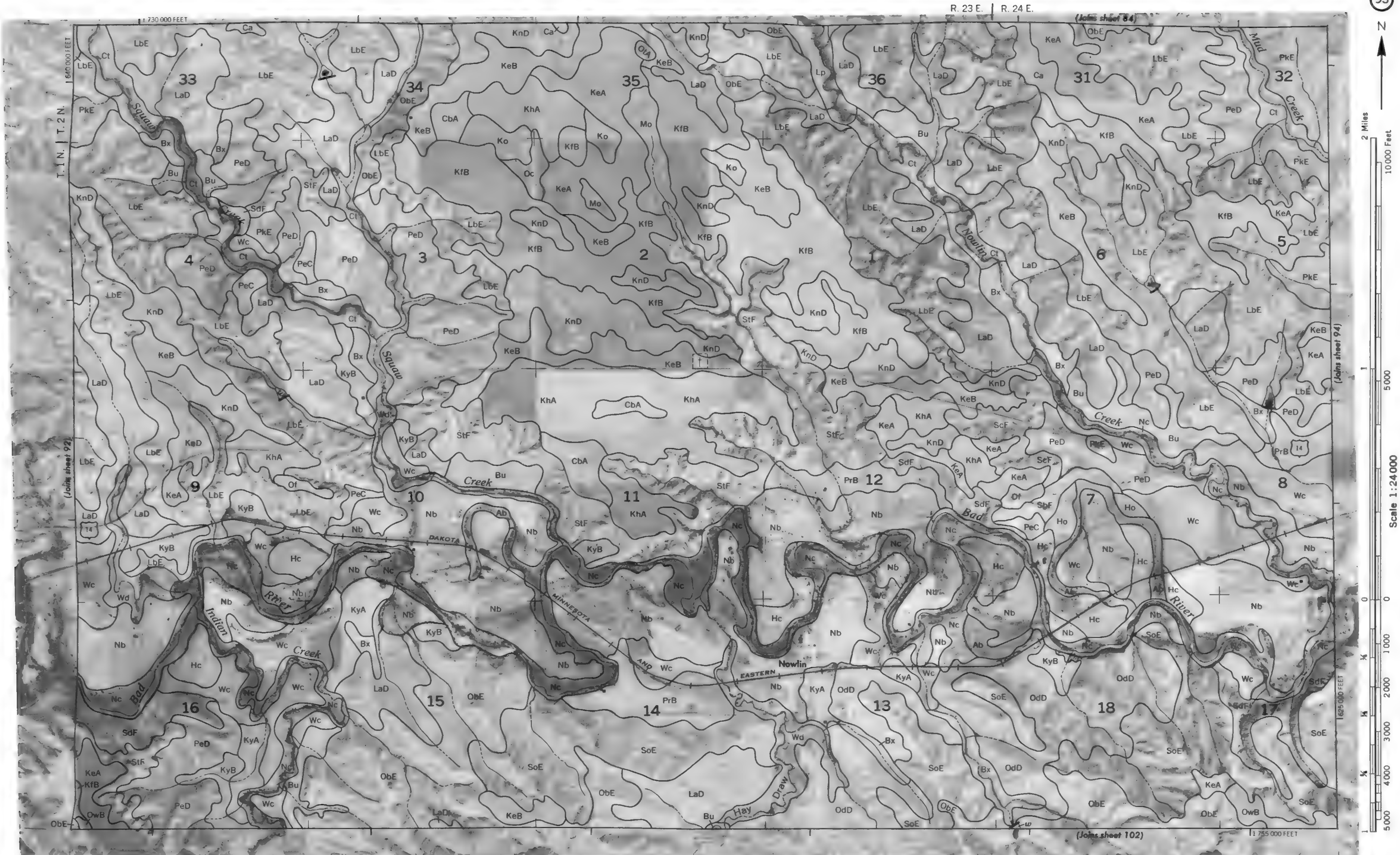
HAAKON COUNTY, SOUTH DAKOTA — SHEET NUMBER 89

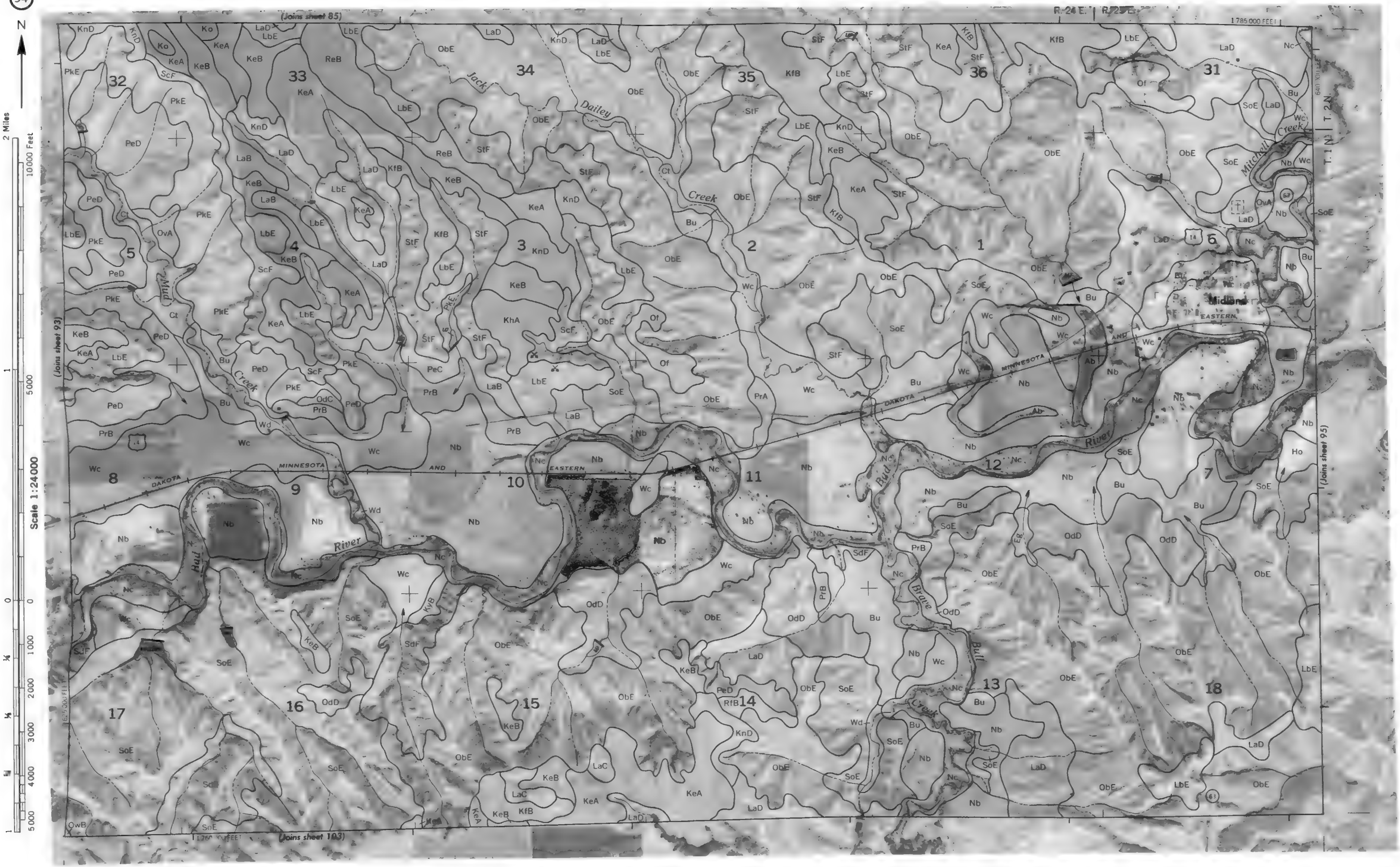


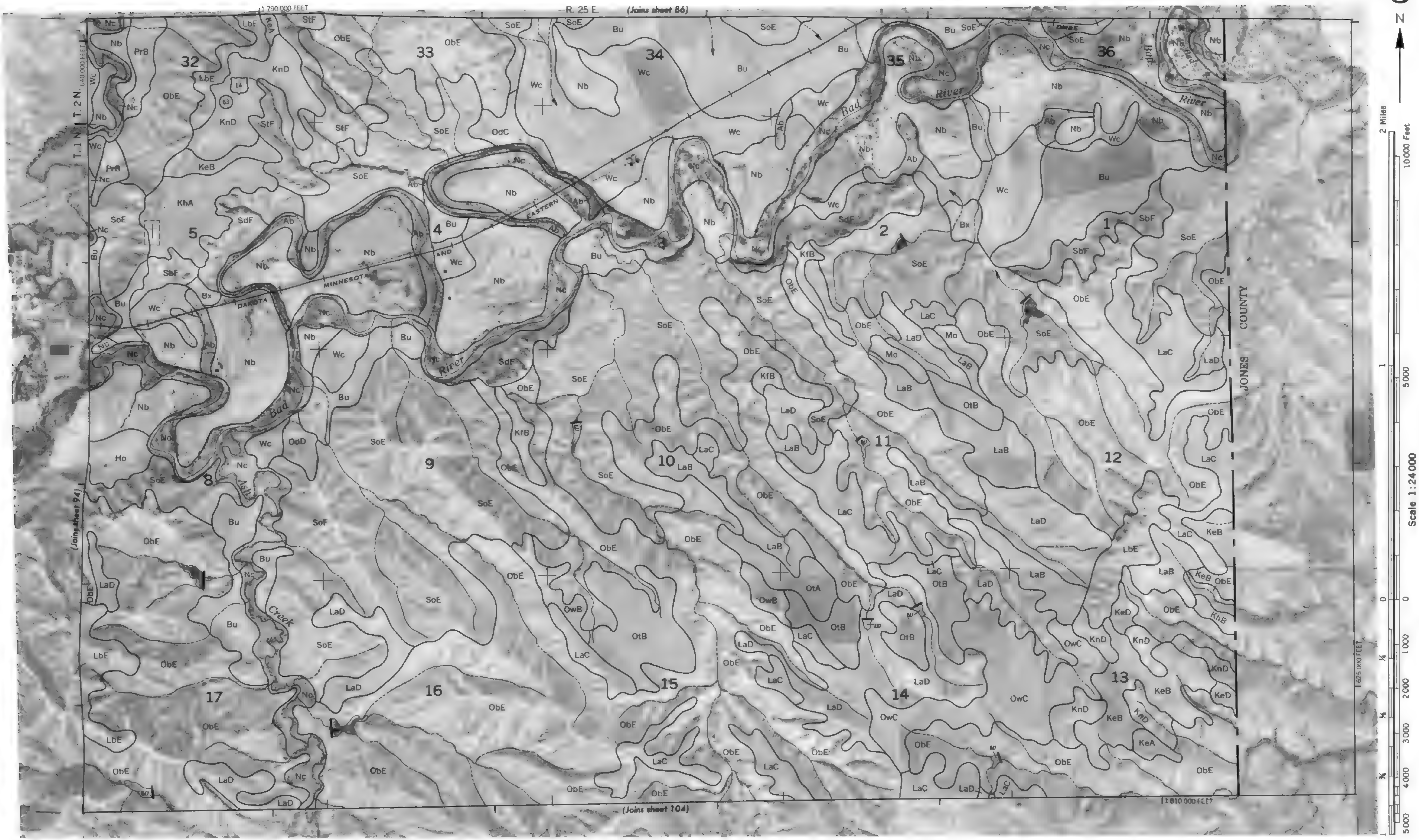

N
(Joins sheet 81)
R. 20 E. | R. 21 E.
(Joins sheet 89)
(Joins sheet 91)
(Joins sheet 99)
T. 2 N.
T. 1 N.
Waggoner Lake
Grindstone Creek
Sunshine Lake
Bad R.
PHILIP
PHILIP MUNICIPAL AIRPORT
MINNESOTA
DAKOTA
EASTERN
Scale 1:24000
2 Miles
10000 Feet
5000
1
0
1000
2000
3000
4000
5000
34
35
36
31
32
33
3
2
1
6
5
4
10
11
12
7
8
9
15
14
13
18
17
16

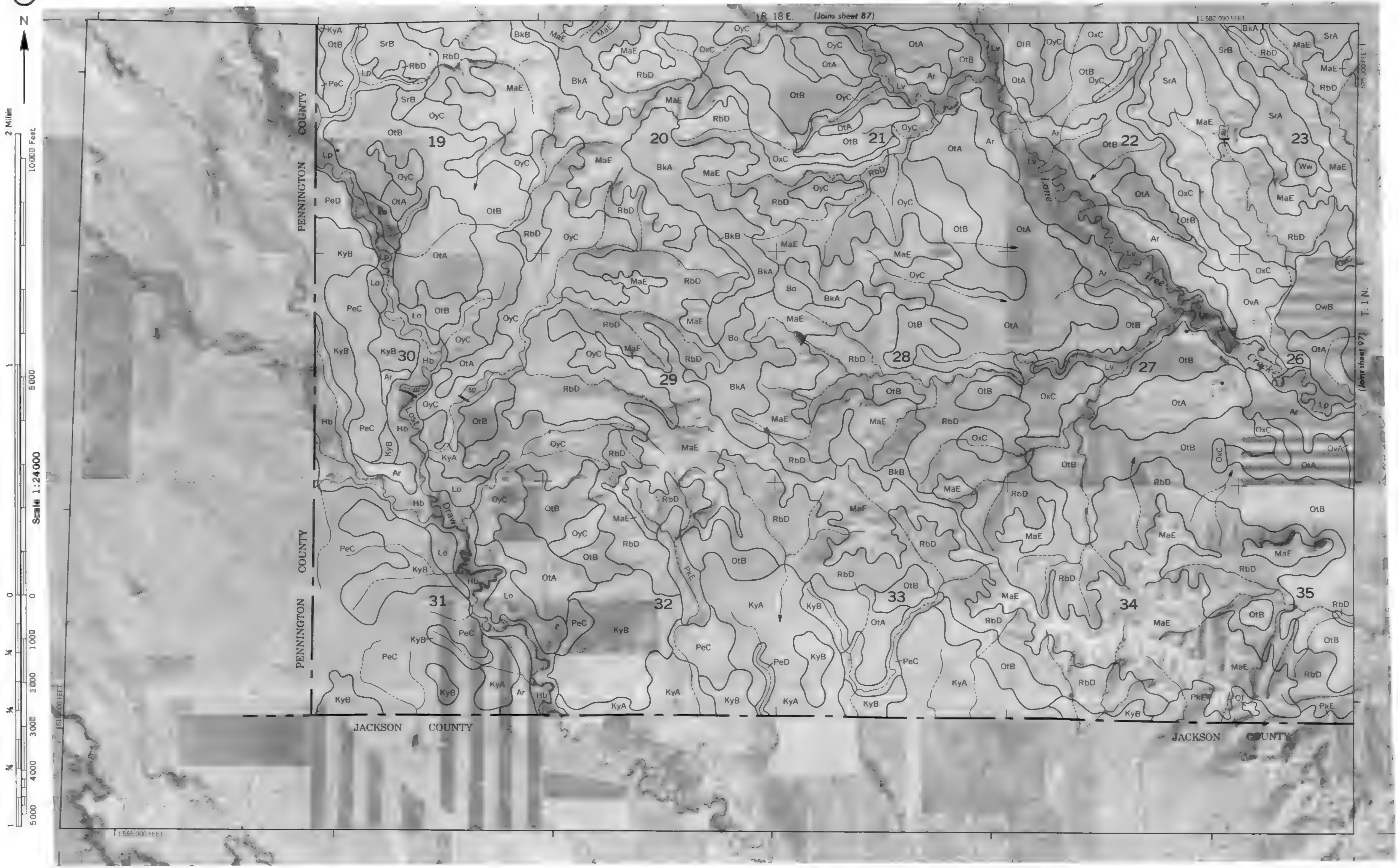

1 675 000 FEET
R. 21 E. | R. 22 E.
(Joins sheet 82)
(Joins sheet 90)
(Joins sheet 92)
(Joins sheet 100)
1 695 000 FEET
T. 1 N. | T. 2 N.
N
Wilburn
Creek
Medicine
Belcher
Draw
Bad
River
DAKOTA
MINNESOTA
AND
EASTERN
14
34
35
36
31
32
33
3
2
1
6
5
4
10
11
12
7
8
9
15
14
13
18
17
16
2 Miles
1
0
10 000 Feet
5000
0
1000
2000
3000
4000
5000
Scale 1:24 000

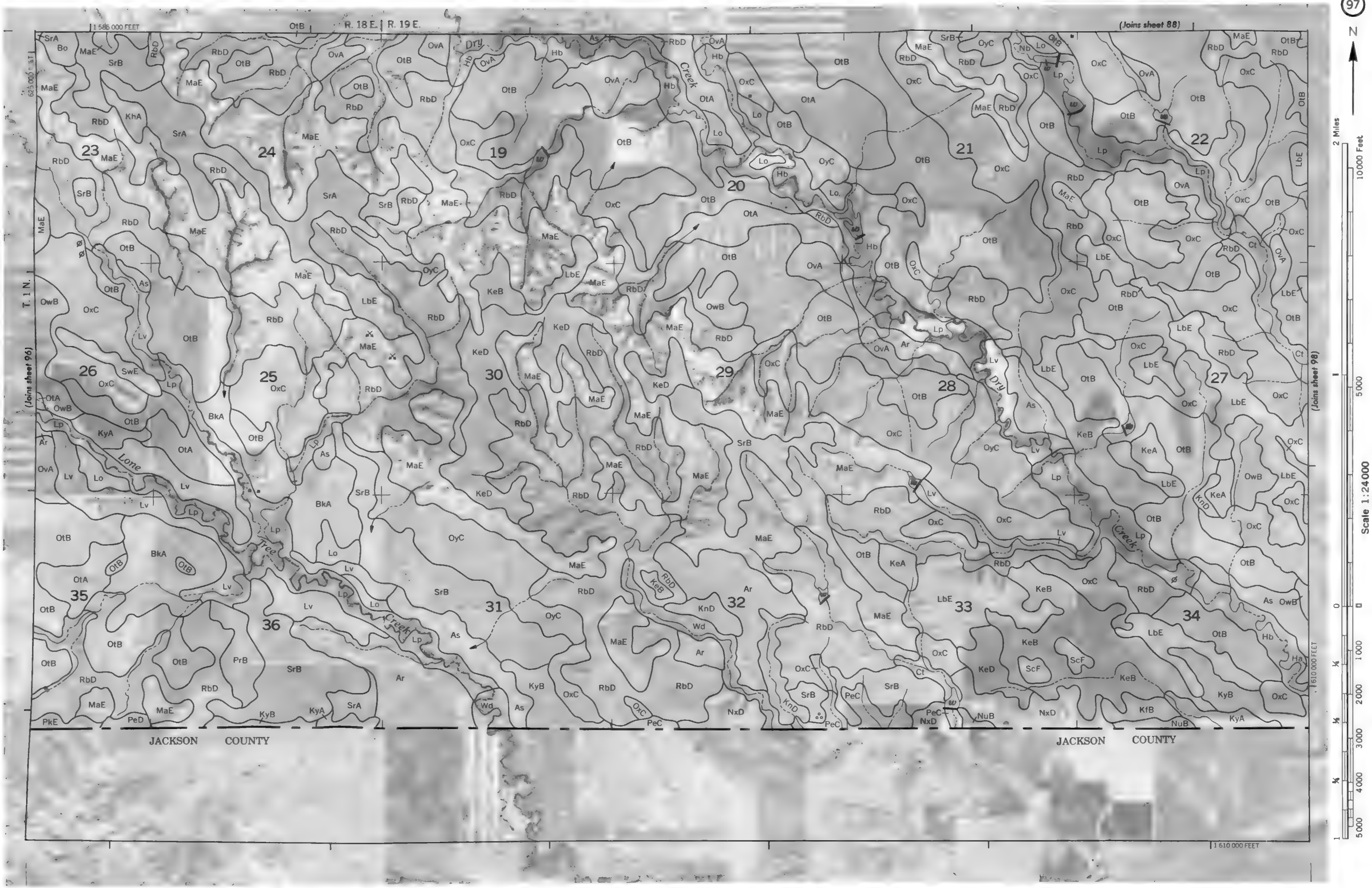

92
N
2 Miles
10 000 Feet
Scale 1:24000
(Joins sheet 91)
(Joins sheet 93)
(Joins sheet 101)
R. 22 E. | R. 23 E.
T. 1 N. | T. 2 N.
1 700 000 FEET
625 000 FEET
Buzzard Creek
Witcher Creek
Bad River
DAKOTA MINNESOTA AND EASTERN


93
N
R. 23 E. | R. 24 E.
(Joins sheet 84)
(Joins sheet 92)
(Joins sheet 94)
(Joins sheet 102)
T. 1 N. | T. 2 N.
1 730 000 FEET
640 000 FEET
625 000 FEET
1 755 000 FEET
2 Miles
10000 Feet
Scale 1:24000
5000
0
1000
2000
3000
4000
5000
33
34
35
36
31
32
4
3
2
1
6
5
9
10
11
12
7
8
16
15
14
13
18
17
Squaw Creek
Nowlin Creek
Mud Creek
Bad River
Indian Creek
Hay Draw
Nowlin
DAKOTA MINNESOTA AND EASTERN
14
LbE
LaD
KnD
KeB
KfB
KhA
KeA
CbA
Ko
Mo
Oc
ObE
PeD
PkE
Bx
Bu
Ct
Wc
Nb
Nc
Hc
Ab
StF
SdF
KyB
KyA
Wd
PrB
SoE
OdD
OwB
Ho
Of
Ca
Lp
ScF
PeC
KaD


N
2 Miles
10 000 Feet
5 000
1
0
Scale 1:24000
(Joins sheet 85)
(Joins sheet 93)
(Joins sheet 95)
(Joins sheet 103)
R. 24 E.
R. 25 E.
T. 2 N.
T. 1 N.
Jack
Dailey
Creek
Mud
Creek
River
Bad
River
Mitchell
Creek
Brave
Bull
Creek
MINNESOTA
AND
DAKOTA
EASTERN
Midland
32
33
34
35
36
31
5
4
3
2
1
6
8
9
10
11
12
7
17
16
15
14
13
18

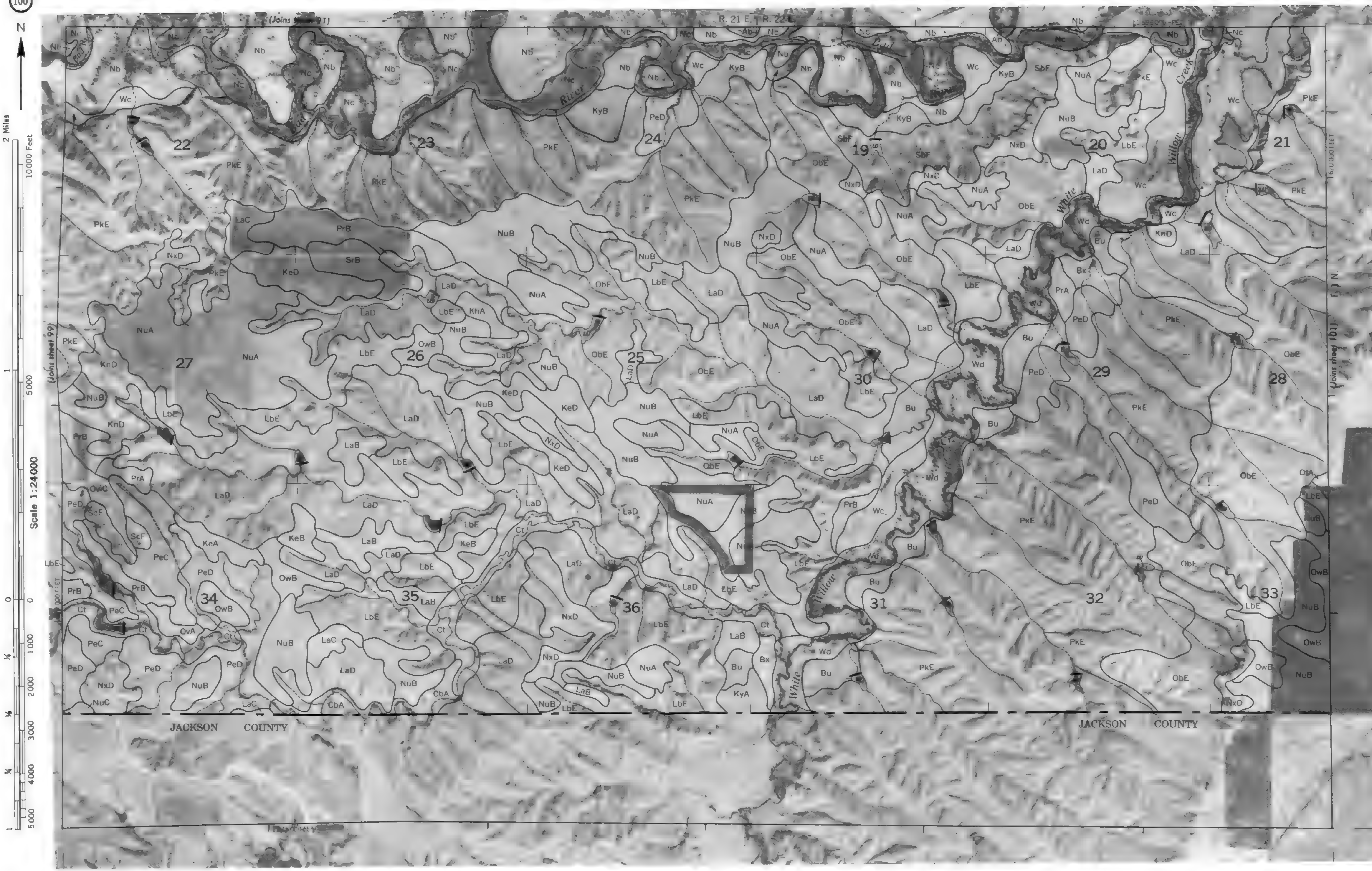

R. 25 E.
(Joins sheet 86)
(Joins sheet 104)
(Joins sheet 94)
1 790 000 FEET
1 810 000 FEET
640 000 FEET
625 000 FEET
T. 2 N.
T. 1 N.
JONES COUNTY
Bad River
Ash Creek
MINNESOTA AND EASTERN
DAKOTA
N
Scale 1:24000
2 Miles
10000 Feet
5000
1
0
1000
2000
3000
4000
5000

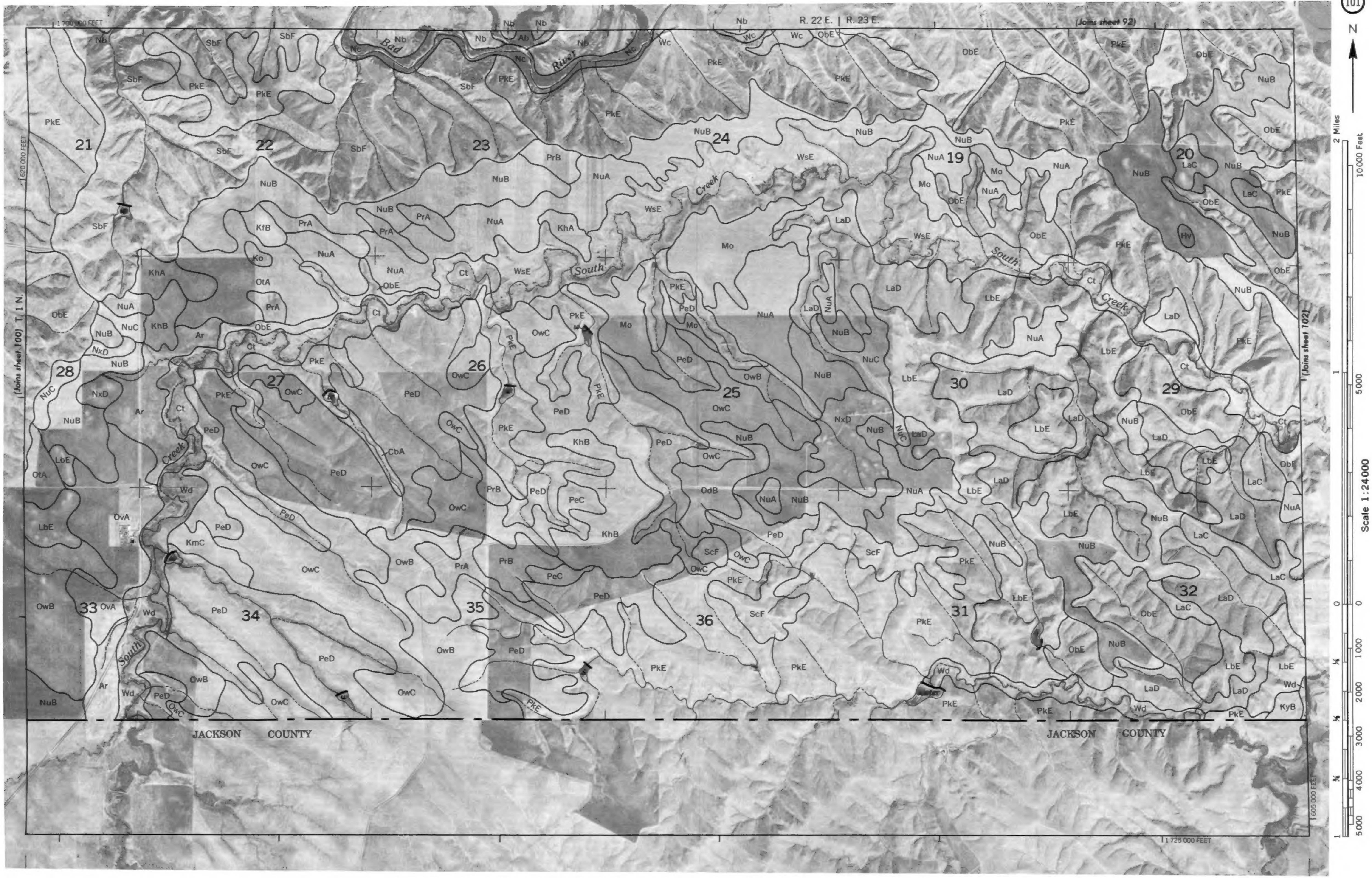

N
2 Miles
10 000 Feet
Scale 1:24 000
R. 18 E.
(Joins sheet 87)
(Joins sheet 97)
T. 1 N.
1 580 000 FEET
1 555 000 FEET
PENNINGTON COUNTY
PENNINGTON COUNTY
JACKSON COUNTY
JACKSON COUNTY
Lone Tree Creek
Lost Draw
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35


97
N
(Joins sheet 88)
(Joins sheet 96)
(Joins sheet 98)
R. 18 E.
R. 19 E.
T. 1 N.
1 586 000 FEET
625 000 FEET
1 610 000 FEET
Dry Creek
Lone Tree Creek
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
JACKSON COUNTY
JACKSON COUNTY
2 Miles
10000 Feet
Scale 1:24000


N
2 Miles
10 000 Feet
Scale 1:24 000
(Joins sheet 89)
R. 19 E. | R. 20 E.
1 640 000 FEET
1 620 000 FEET
T. 1 N.
(Joins sheet 97)
(Joins sheet 99)
1 610 000 FEET
1 615 000 FEET
South Fork Bad River
Eastern
Minnesota and Dakota
Bad River
14
JACKSON COUNTY
JACKSON COUNTY
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
OtB
OxC
RbD
KfB
PeD
LbE
OwB
KeA
KeB
KnD
KmB
Ct
StF
Ca
KhB
KeD
PeC
LaD
LaC
LaB
CbA
OvA
Bu
KhA
OtA
PkE
Cv
Nc
Of
Ab
NuA
Bx
ScF
Nb
Wc
PrA
PeC
ObE
MaE
Ha
Hb
As
KyA
KyB
Wd
SdF
PrB
LaB

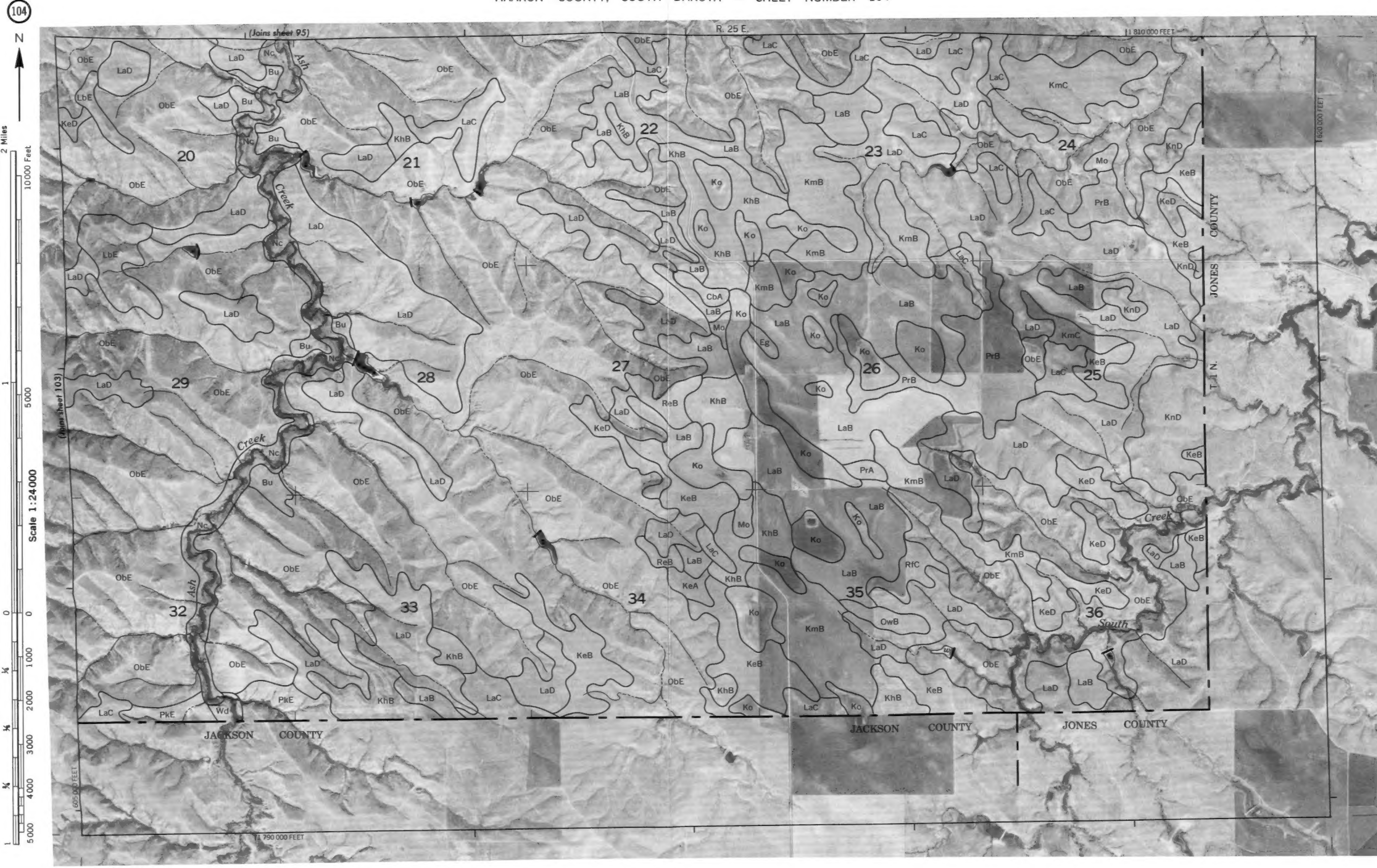

99
(Joins sheet 90)
(Joins sheet 98)
(Joins sheet 100)
R. 20 E.
R. 21 E.
T. 1 N.
PHILIP
Bad River
North Fork
South Fork
CHICAGO AND NORTH WESTERN
MINNESOTA AND DAKOTA
JACKSON COUNTY
JACKSON COUNTY
N
2 Miles
1
0
10000 Feet
5000
0
1000
2000
3000
4000
5000
Scale 1:24000
1 670 000 FEET
620 000 FEET
610 000 FEET


N
(Joins sheet 91)
R. 21 E.
R. 22 E.
(Joins sheet 99)
(Joins sheet 101)
T. 1 N.
Bad River
White River
Willow Creek
Willow Cr.
JACKSON COUNTY
JACKSON COUNTY
Scale 1:24 000
2 Miles
1
0
10000 Feet
5000
0
1000
2000
3000
4000
5000
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36


101
N
(Joins sheet 92)
R. 22 E. | R. 23 E.
1 700 000 FEET
620 000 FEET
(Joins sheet 100) T. 1 N.
(Joins sheet 102)
Bad River
South Creek
JACKSON COUNTY
JACKSON COUNTY
605 000 FEET
1 725 000 FEET
2 Miles
10 000 Feet
Scale 1:24000
21
22
23
24
19
20
26
25
27
28
30
29
33
34
35
36
31
32


N
2 Miles
10 000 Feet
5 000
Scale 1:24 000
(Joins sheet 93)
(Joins sheet 101)
(Joins sheet 103)
R. 23 E.
R. 24 E.
T. 1 N.
1 755 000 FEET
605 000 FEET
1 730 000 FEET
JACKSON COUNTY
JACKSON COUNTY
South Creek
Indian Creek
Creek
Hay Draw
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36


103
(Joins sheet 94)
R. 24 E. | R. 25 E.
N
1 760 000 FEET
T. 1 N.
(Joins sheet 102)
(Joins sheet 104)
605 000 FEET
1 785 000 FEET
JACKSON COUNTY
JACKSON COUNTY
Bull Creek
Brave
Scale 1:24 000
2 Miles
10000 Feet
5000
1
0
½
¼
1000
2000
3000
4000
5000
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36


104
N
(Joins sheet 95)
R. 25 E.
1 810 000 FEET
620 000 FEET
(Joins sheet 103)
JONES COUNTY
T. 1 N.
Ash Creek
South Creek
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
JACKSON COUNTY
JACKSON COUNTY
JONES COUNTY
605 000 FEET
1 790 000 FEET
2 Miles
10 000 Feet
Scale 1:24 000